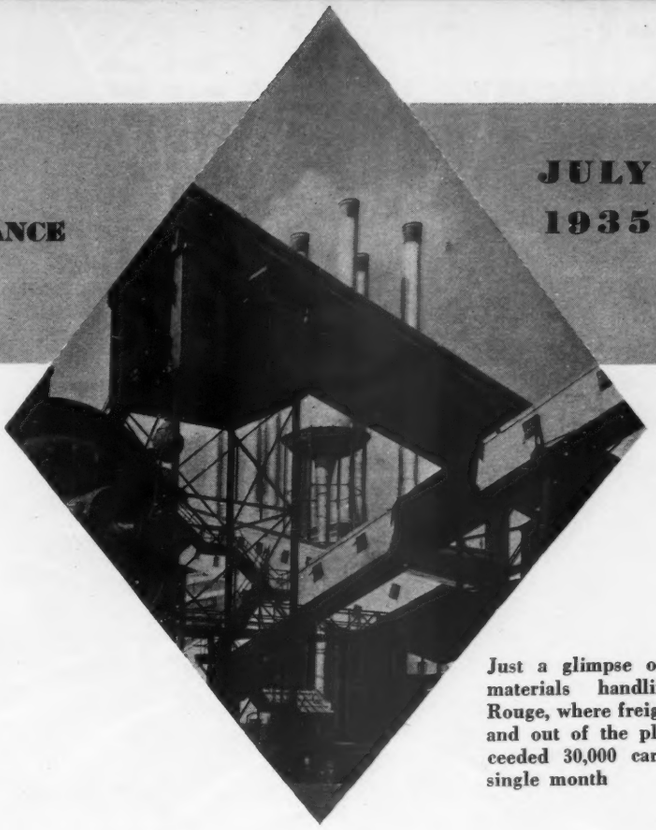
FACTORY
MANAGEMENT and MAINTENANCE
L. C. MORROW
Editor
JULY
1935



Just a glimpse of Ford materials handling at Rouge, where freight into and out of the plant exceeded 30,000 cars in a single month

Better Handling Bigger Net

THERE are many reasons why manufacturing plants should make full use of materials handling equipment *any year*. They are detailed in the leading article of this issue's Special Section.

There are equally good reasons why manufacturing plants should make full use of materials handling equipment *this year*.

Potent among them—in fact summarizing them all—is the need for low-cost production to bring about wide distribution, which *is* prosperity.

Today wages are high in proportion to volume of production. The trend still is upward. Material costs are high. Indirect expense is high. Rightly, or wrongly, these are facts.

They are facts that make it imperative for management to so order plant operation that there will be minimum waste in useless work. Any manual handling that can be done at less expense by equipment is useless work. Any handling by equipment that can be done at lower cost by better equipment is useless work.

By eliminating handling wastes management is finding a way to make profits in spite of high wage rates and shorter hours of work. It is putting itself in position to prove again the soundness of the industry-discovered principle that high wages, low costs, low prices are responsible for prosperity in an economy such as ours.

There will be no better time than now to begin to take advantage of the savings available in handling.

Equipment for materials handling will never cost less.

Skilled mechanics now are available to build and install the equipment. They will be scarce later on—are scarce now in some lines.

Some men already on manufacturing payrolls have not enough to do, can pinch-hit on the installation.

Although plants are getting busier, materials handling systems still can be revised and equipment installed without serious interruption to production.

Quick delivery on handling equipment can be given now. Slow delivery is inevitable later.

MAKERS of handling equipment have not been idle during the depression. Their equipment is better than ever today. In practically all lines changes have been effected that will reduce operating and maintenance costs. Improvements in design have made existing equipment in many plants obsolescent, in some obsolete.

Manufacturing plants have paid little attention to handling economies for the past five years. They were busy finding work to keep people on their payrolls. Humane, but not productive of prosperity in the long run. With business improving they can now see that these people do productive work, leave handling to machinery.

Manufacturers owe it to themselves to start recovery right, and then to do all that they can to climb the recovery incline quickly, to prolong the next level of prosperity, and to enjoy net profit during the two periods.

They can do these things by making products at lowest manufacturing cost.

And to do that they must take full advantage of technological developments in methods and equipment.

This means taking advantage of all that materials handling equipment offers.

It means that now is the time to do so.

Taking advantage of technological development in the automotive industry (Packard 120)

If technological improvements were the basic reason for unemployment, the great mass of people out of work would be found among the users of mass production machines. On the contrary, unemployment exists in its greatest intensity in those industries which are not geared or cannot be geared to mass production methods, using the so-called labor saving machinery.

—HERMAN LIND, *General Manager, National Machine Tool Builders' Association*

Still Rocking the Boat

L. C. MORROW
Editor

IT IS impossible to see how legislation giving the Federal government jurisdiction over anything "tending to lead to a labor dispute that might burden or affect commerce" (Wagner-Connery Labor Relations Act) can be any more popular or any better enforced than was prohibition. But the attempt at enforcement will be made, the water of industrial harmony, of recovery, will be muddied.

There is hope for a Supreme Court decision that the act is unconstitutional. Consider the Court's unanimous decision in the Schechter case, that "where the effect of intrastate transactions upon interstate commerce is merely indirect, such transactions remain within the domain of state power. * * * Persons employed * * * in local trade are not employed in interstate commerce. Their hours and wages have no direct relation to interstate commerce." Litigation, plenty of it, is bound to come. Let us hope for a test case promptly.

If one man offers to sell another a horse, and the other says "No," there has been no bargaining. If employees say to their employer "We want more money," and he says "No," there has been no bargaining. Yet, according to the bill, the employer must bargain: It is "an unfair labor practice" for an employer "to refuse to bargain collectively with the representatives of his employees." Presumably, whether the employer has the money or not, he must give to his "bargaining" employees some part of what they ask.

Not by educational procedure, such as is possible under employee representation plans, to establish the mutuality of interest of employer and employee, but by setting up two camps of apparently different interests, are labor disputes to be settled, even avoided.

Somewhere poor psychology has been used. Somehow, by this bill, somebody's conception of reform has been superimposed upon somebody's conception of recovery and how to get it.

Wages go up and down with depression and prosperity. It is just as impossible as ever to legislate into the hands of labor more than the value of production justifies. The New Deal still rocks the boat.

No Test

One of the first rules the engineer learns is that, in making a test, only one variable at a time can be changed. Taylor would have gotten nowhere in his metal cutting tests had he changed speed, feed, and depth of cut all at the same time.

There is an analogy in the recovery (or reform) tests now being attempted by the Administration. The NIRA variable was changed by the Supreme Court. Almost immediately it became known that industry would be watched by the NRA organization, by Treasury Department, by A. F. of L., to see whether it could do for recovery what it has said all along it can do.

However, now there can be no test. Under the NIRA, industrial operation was free from a Labor Disputes Act, a Social Security Act, a Banking Act, and a Holding Company Act. Obviously, any fair test of operation without a NIRA would retain that status of freedom. It does not, because these measures are either present fact or likely prospect.

If business now recedes, there can be no proof that elimination of the NIRA was the cause. If it goes forward, that desirable movement may come about in spite of the changed reform variables, rather than because of them.

The experiment is automatically disqualified. There is no test.

NIRA's Passing

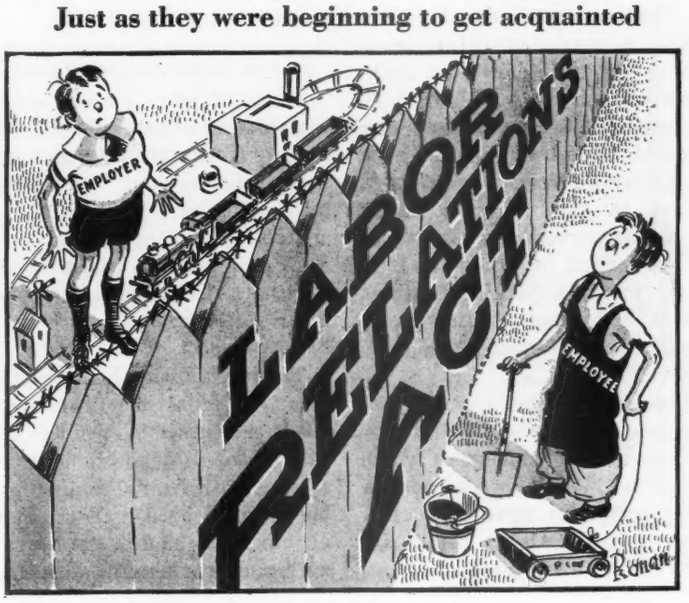
Nothing very serious has happened since the Supreme Court's NRA decision. True, there have been accusations of rate cutting and hour extension, but with little citing of specific cases.

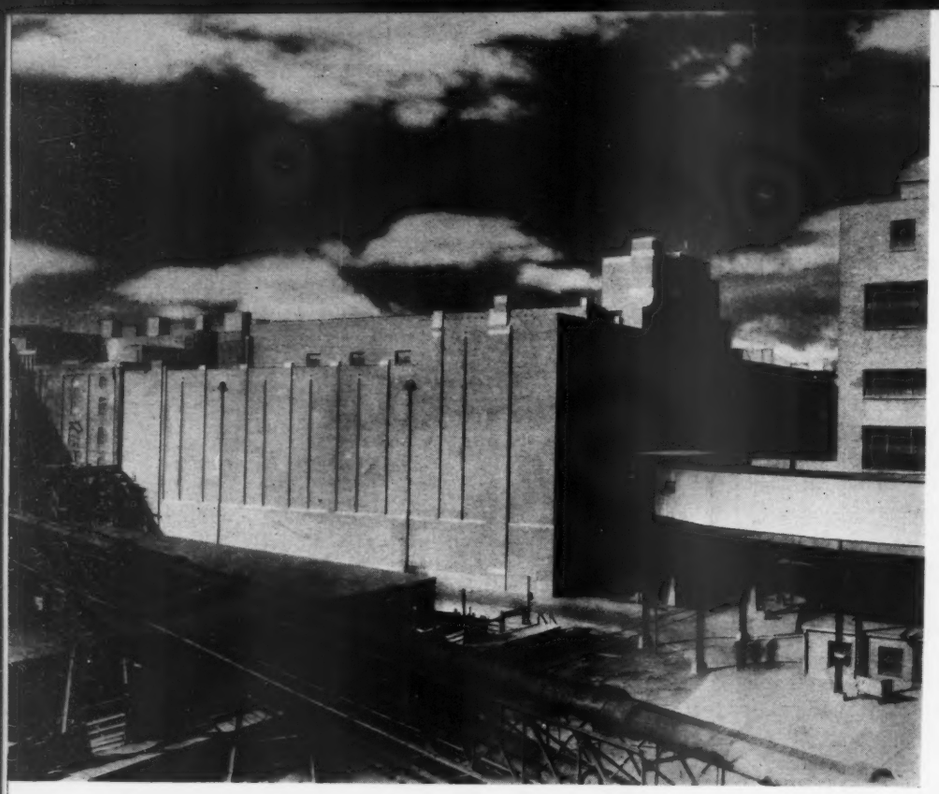
On the other hand, single industrial plants and whole industries have announced their adherence to the hour and wage standards as set up under the codes, and their intention to follow standards of fair practice. Several leading companies have announced wage increases.

Thus we have had concrete evidence of the ability and willingness of industry and business to do what they say should be done to accelerate recovery.

There are difficulties ahead. Some code provisions were not in the public interest; they will have to be abandoned in voluntary pacts. The anti-trust laws are again in effect and may greatly limit voluntary agreements. A real cooperation between business and government will be able to accomplish much. Business has shown it wants to cooperate.

Just as they were beginning to get acquainted





Took $400,000 Plunge

Found the water fine. Concern with narrow profit margin discovers how well it pays to go ahead with plant extension and betterment

GEORGE M. FOSTER
Vice-President, John Morrell & Company
Ottumwa, Iowa

THE BROADER the margin of profit, the duller the urge to the utmost efficiency in operating. The narrower the margin, the keener the urge. These are truisms.

Ours is a narrow-margin line if ever there was one. In meat packing, competition is so keen that no luxurious profit percentage may ever be expected. The best one may hope for is anywhere from 1 cent to 2 cents net on the dollar of sales, which means perhaps one-eighth of a cent per pound of product. It is very easy to run a packing business so that this expected fractional cent is not earned. It is much less easy to earn it regularly.

That we have earned a profit year in and year out for a great many years is an accomplishment of which we are proud. We know, of course, that we have been fortunate; after all, even in a depression, people are going to eat. We are therefore guaranteed some volume of sales. But in hard times it is a good deal more difficult to earn a net profit—which brings us to the major point of this article.

You Know All the Arguments

Many of our friends have from time to time expressed astonishment, heavily tinged with dismay, at what they consider our recklessness in purchasing new equipment and increasing plant capacity at so unfavorable a moment. (This moment, be it remarked in passing, has persisted for a full five years, with no immediate prospect of its parting.

Their arguments have the familiar ring: Current conditions are not good; the future is even less certain; discretion demands holding on to surplus cash firmly, against a possible future need. You know the arguments. You have heard them over and over again.

Our creed runs almost directly contrary to these ideas. We are not ready to admit that the United States and the world at large are going to the dogs—and if we are guessing wrong and if they are about to break up, then we shall be no worse off for having spent some of our cash for new buildings and equipment. Assuming, then, that we are likely to remain in business for a good many years, certainly we want to maintain our production, plant, and equipment at a high level of efficiency. Even more certainly, we need the greatest possible efficiency in times like these when profits are hard to make.

Full Speed Ahead

So we have gone ahead with plant extensions and betterments precisely as though no depression had come to afflict industry. In 1933 we erected one plant building which is our largest single unit and the last word—to date—for its purpose. We have kept our equipment modern by judicious replacements here and there, until our plant has reached the point where we know of no other in our industry more advanced in design and equipment. And proof of the policy is that we have continued making an annual net profit throughout the depression years, which is rather better than many meat packers have been able to do.

It is not as if this were for the sole and selfish advantage of the owners of the business. Contrary to the generally broadcast ideas of a good many economic faddists, this is likewise to the direct advantage of our employees, of the communities in which we operate, and of consumers everywhere. If these assertions seem rather broad, suppose we trace them back to the facts on which they are based.

When we moved into our new hog cutting building in 1933, we were immediately able to release to other employment around the plant a substantial number of men who had worked at the cutting tables in our old plant. To say it another way, the new equipment increased the pounds of product per man-hour, or reduced the labor content per pound of product. Surely, by the economic theories now prevalent in some places, this must necessarily increase

unemployment and plunge our community further into the slough of depression.

Actually it worked out exactly opposite. Somehow we managed to get a good deal more business. My personal belief has been that a major reason why we could obtain this new business was because the slightly reduced production cost permitted us to put a little more promotional effort behind our line. Anyhow, our employment climbed steadily upward, as it has been climbing since my great-grandfather founded the business in 1827. It climbed to its all-time peak by last December, when we had to begin laying off men. All meat packers had to lay off men then, and have continued laying them off ever since.

Up Two Places

The reason is beyond the control of anyone in our industry. Drought, piled on top of artificial control of feed supplies and live stock supplies, so reduced the number of cattle and hogs in this country that a greatly reduced number is coming to market. And when we cannot obtain the animals to slaughter, we cannot provide employment.

At that, national figures for the industry covering the week before this is written showed that from our customary rank we had climbed up two places in number of hogs dressed. The answer, we are guessing, is that our production economies permitted us to pay somewhat more for hogs than could some older plants. Therefore the hog raisers shipped us disproportionately more hogs than usual. And the three cities where we have packing plants —Ottumwa, Sioux Falls, and Topeka— certainly have benefited by the greater employment resulting from our increased business.

"We are not ready to admit that the United States and the world at large are going to the dogs—and if we are guessing wrong and if they are about to break up, then we shall be no worse off for having spent some of our cash for new buildings and equipment. Assuming, then, that we are likely to remain in business for a good many years, certainly we want to maintain our production, plant, and equipment at a high level of efficiency. Even more certainly, we need the greatest possible efficiency in times like these when profits are hard to make."

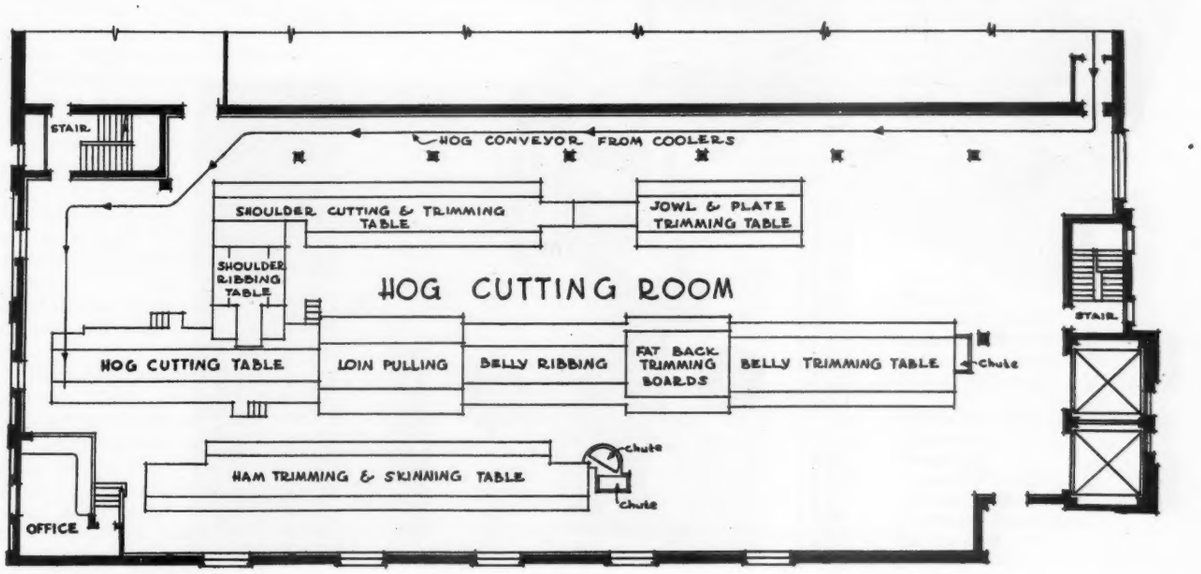
While we have never formulated a definite expansion policy or equipment replacement policy, it might be stated approximately as follows: Three major factors influence capital expenditures on plant. These are need for added capacity, opportunity to decrease costs, desirability of keeping abreast of technical development along such lines as product betterment, improved sanitation, and other equally important projects.

Any one of the three may conceivably influence us to make a sizable expenditure. In practice, however, one is seldom encountered unaccompanied by the other two. By growing steadily we have a rather constant need for added capacity. Equipment makers and engineers keep developing less expensive production and handling methods. A better product is worth having whenever the improvement can be substantial; better sanitation leads to reduced costs and better products, besides being inherently desirable in its own right. So it becomes unavoidable every now and then that we put up a new building to house new equipment or that we revamp a department or section.

Had to Have More Capacity

Consider the pork cutting floor already referred to. Our old building had a wooden floor, which frequently required renewal. The work, which consists essentially of disassembling a hog into its component parts, had to be pushed along from man to man down the tables—and hogs and hams and shoulders and middles weigh rather heavy. We needed more capacity, we needed lower costs, we could improve sanitation and product. So we took the plunge, spent $400,000 in the dark days of 1933, and presently moved in. The results have already been mentioned.

(A second article, scheduled for August publication, will describe the layout of the new hog cutting floor —reproduced at the bottom of the page—in complete detail.—Ed.)



24 Murals

Beautify this plant, sell visitors on the idea of porcelain enamel

NO MONOPOLY on murals has Ever Ready Label (see February, page 59). In sheer number of murals, at any rate, it is completely outdone by Ferro Enamel Corporation, Cleveland, where twenty-four adorn reception room, hallways, and general offices. They depict industrial scenes, show latest in refrigerators, washing machines, bathroom equipment, cooking ranges, cooking utensils.

These murals, you may be sure, are porcelain enamel on steel. In gray, cobalt, black, white, and ivory, with touches of red, they indicate the variety of color and wide utility of this material for modern industrial products.

The Conditions Audit

A new approach to the old, old problem of making sure that things in the plant are going the way they're supposed to go

H. E. BOYD
Industrial Engineer
The Berger Brothers Company, New Haven

MAINTENANCE of correct conditions is a management function, and most superintendents and managers plan to make inspections, either periodic or irregular. Management, however, is charged with responsibility for daily operation, which entails such constant attention and hour-by-hour interruptions and demands that the tendency is to neglect such surveys much of the time or, when made, to make them hurriedly and incompletely.

Instructions for Audit

Effective criticism and indefatigable follow-ups are best had through regular, systematic, impartial inspections and reports by someone representing the general management. In a specific case with which I am familiar the undesirable situation described was corrected by the work of a Conditions Audit Committee. The composition and procedure of this committee are best described by the instructions which created it.

Purpose: To establish and preserve normal conditions of plant, equipment, and material by:

1. Defining standard conditions.
2. Providing a monthly check-up and report of actual conditions with recommendations for betterment.
3. Determining for each department head a monthly rating on conditions.

Standards: (a) Normal conditions of plant, equipment, and material for the purpose of the audit shall be:

1. Equipment maintained in a good state of repair, in proper locations, orderly, neat, adequate, and in proper quantity.
2. Material maintained in proper locations and quantities, orderly and neat.
3. Personal property of employees (clothing, shoes, lunches, etc.) kept in proper locations, neat and orderly.

(b) Department heads are responsible to a great extent for the maintenance of standard conditions. The good department head continually exerts his influence indirectly on those not under his line authority to get things done that affect his department.

The responsibility of department heads and others is defined in bulletins, official pamphlets, instructions, policy and method books, planning instructions, letters, posters, verbal instructions, and other papers. It is further covered, and very largely, by custom and tradition and what is considered good practice. Nothing in the instructions lessens the duty of line authorities to secure efficient discharge of these responsibilities.

Audit: (a) A Conditions Audit Committee shall consist of the Industrial Engineer as Chairman, the Personnel Supervisor, and the Safety Engineer.

(b) At least once a month the Committee shall inspect each department and record all non-standard conditions for which department heads are responsible.

(c) The Committee shall determine in its best judgment what the responsibilities of department heads are and shall classify under equipment, material, and personal property the non-standard conditions found, and shall assign a rating to each department on each of the three points and also a rating on each department as a whole which shall be the total percentage given on the above three points, divided by three. Monthly, not later than the fifth of the month following the month during which the audit was made or the first working day thereafter, the Committee Chairman shall make a written report to each Division Chief of the non-standard conditions so found in each of the departments under his line authority and shall distribute the copies of each Division Chief's report indicated by the accompanying table. At the bottom of each report the Committee Chairman shall show the average percentage for all the departments rated in each group.

(d) The audit is authorized for each of the departments mentioned in the second column of the table.

Action by Division Chiefs and Department Heads: (a) When the Division Chief receives the Committee's Report, he shall send to each department head a copy of the report on his de-

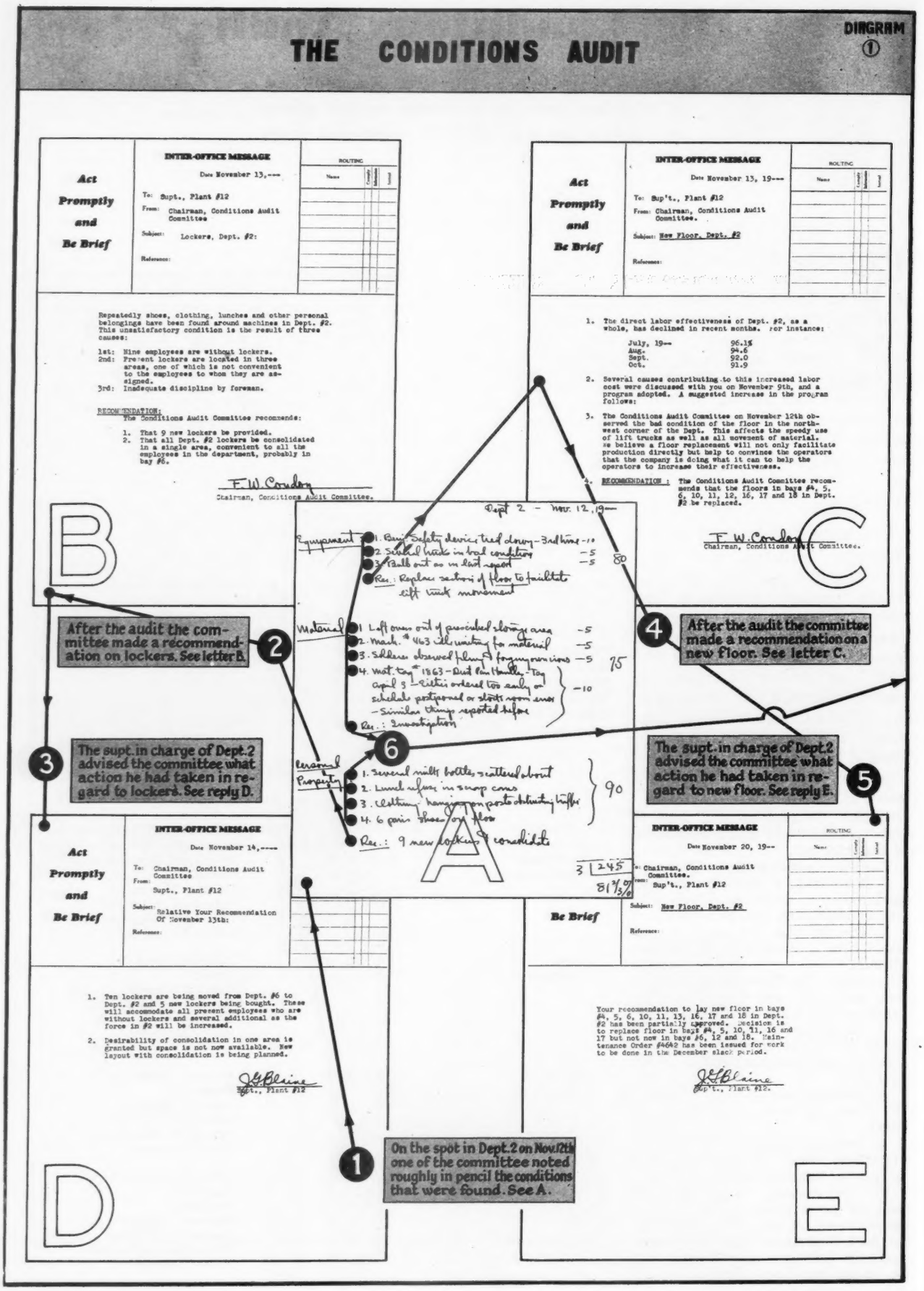
(Illustrations on three following pages, text on advertising page 55)

Table I. Division Chief's Report

Report to	*Covering Departments*	*No. Each Report Needed*	*Copies to*
Production Superintendent	2- 3- 4- 6 8-12-14-16 20-21-22-23 24-26-27-28	7	Production Superintendent (2) President General Manager Industrial Engineer Personnel Supervisor Safety Engineer
Plant Engineer	70-71-72-83 84-90	7	Plant Engineer (2) President General Manager Industrial Engineer Personnel Supervisor Safety Engineer
Material Controller	52-53-54-60 61	7	Material Controller (2) President General Manager Industrial Engineer Personnel Supervisor Safety Engineer
Office Manager	30-31-32-33 34-35-36-37 38-39	8	Office Manager (2) Controller President General Manager Industrial Engineer Personnel Supervisor Safety Engineer

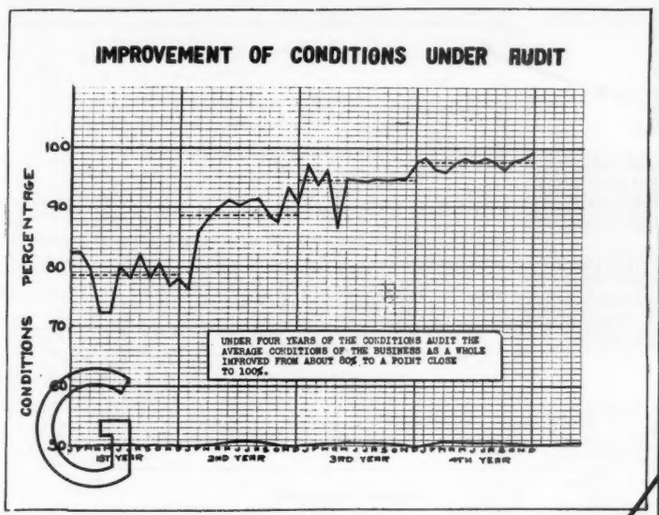
THE CONDITIONS AUDIT

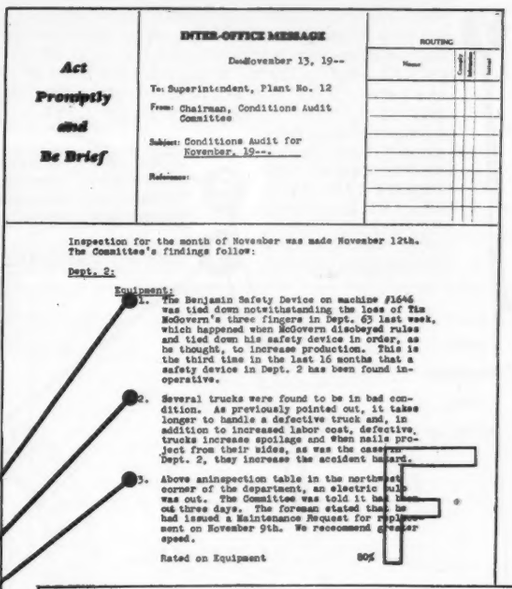
DIAGRAM 1


Act Promptly and Be Brief
INTER-OFFICE MESSAGE
Date November 13,---
To: Supt., Plant #12
From: Chairman, Conditions Audit Committee
Subject: Lockers, Dept. #2:
Reference:
ROUTING
Name
Comply
Initial
Repeatedly shoes, clothing, lunches and other personal belongings have been found around machines in Dept. #2. This unsatisfactory condition is the result of three causes:
1st: Nine employees are without lockers.
2nd: Present lockers are located in three areas, one of which is not convenient to the employees to whom they are assigned.
3rd: Inadequate discipline by foreman.
RECOMMENDATION:
The Conditions Audit Committee recommends:
1. That 9 new lockers be provided.
2. That all Dept. #2 lockers be consolidated in a single area, convenient to all the employees in the department, probably in bay #6.
F.W.Condon
Chairman, Conditions Audit Committee.
B
Act Promptly and Be Brief
INTER-OFFICE MESSAGE
Date November 13, 19---
To: Sup't., Plant #12
From: Chairman, Conditions Audit Committee.
Subject: New Floor, Dept. #2
Reference:
1. The direct labor effectiveness of Dept. #2, as a whole, has declined in recent months. For instance:
July, 19-- 96.1%
Aug. 94.6
Sept. 92.0
Oct. 91.9
2. Several causes contributing to this increased labor cost were discussed with you on November 9th, and a program adopted. A suggested increase in the program follows:
3. The Conditions Audit Committee on November 12th observed the bad condition of the floor in the northwest corner of the Dept. This affects the speedy use of lift trucks as well as all movement of material. We believe a floor replacement will not only facilitate production directly but help to convince the operators that the company is doing what it can to help the operators to increase their effectiveness.
4. RECOMMENDATION: The Conditions Audit Committee recommends that the floors in bays #4, 5, 6, 10, 11, 12, 16, 17 and 18 in Dept. #2 be replaced.
F.W.Condon
Chairman, Conditions Audit Committee.
C
Dept 2 - Nov. 12, 19---
Equipment
1. Emg. Safety device tried down - 3rd time -10
2. Several trucks in bad condition -5
3. Pulled out as in last report -5
Rec.: Replace section of floor to facilitate lift truck movement
80
Material
1. Left overs out of specified storage area -5
2. Mach. #463 ill waiting for material -5
3. Scheduled observed filling of foreign operations -5
4. Mat. tag #1863 - Bent Pan Handle - Tag April 3 - Girls ordered too early on schedule postponed or stock room error - Similar things reported before -10
Rec.: Investigation
75
Personal Property
1. Several milk bottles scattered about
2. Lunch refuse in scrap cans
3. Clothing hanging on posts obstructing traffic
4. 6 pairs shoes on floor
90
Rec.: 9 new lockers & consolidate
A
3 245
81 3/5 0
After the audit the committee made a recommendation on lockers. See letter B.
2
After the audit the committee made a recommendation on a new floor. See letter C.
4
3
The supt. in charge of Dept. 2 advised the committee what action he had taken in regard to lockers. See reply D.
6
The supt. in charge of Dept. 2 advised the committee what action he had taken in regard to new floor. See reply E.
5
Act Promptly and Be Brief
INTER-OFFICE MESSAGE
Date November 14,----
To: Chairman, Conditions Audit Committee
From: Supt., Plant #12
Subject: Relative Your Recommendation Of November 13th:
Reference:
1. Ten lockers are being moved from Dept. #6 to Dept. #2 and 5 new lockers being bought. These will accommodate all present employees who are without lockers and several additional as the force in #2 will be increased.
2. Desirability of consolidation in one area is granted but space is not now available. New layout with consolidation is being planned.
J.G.Blaine
Supt., Plant #12
D
Be Brief
INTER-OFFICE MESSAGE
Date November 20, 19--
To: Chairman, Conditions Audit Committee.
From: Sup't., Plant #12
Subject: New Floor, Dept. #2
Reference:
Your recommendation to lay new floor in bays #4, 5, 6, 10, 11, 13, 16, 17 and 18 in Dept. #2 has been partially approved. Decision is to replace floor in bays #4, 5, 10, 11, 16 and 17 but not now in bays #6, 12 and 18. Maintenance Order #46A2 has been issued for work to be done in the December slack period.
J.G.Blaine
Sup't., Plant #12.
E
On the spot in Dept. 2 on Nov. 12th one of the committee noted roughly in pencil the conditions that were found. See A.
1

THE CONDITIONS AUDIT

DIAGRAM ②




Act Promptly and Be Brief

INTER-OFFICE MESSAGE

Routing: Mason, Conklin, Smith

Dec November 13, 19--

To: Superintendent, Plant No. 12

From: Chairman, Conditions Audit Committee

Subject: Conditions Audit for November, 19--.

Reference:

Inspection for the month of November was made November 12th. The Committee's findings follow:

Dept. 2:

Equipment:

1. The Benjamin Safety Device on machine #1646 was tied down notwithstanding the loss of Tim McGovern's three fingers in Dept. 63 last week, which happened when McGovern disobeyed rules and tied down his safety device in order, as he thought, to increase production. This is the third time in the last 16 months that a safety device in Dept. 2 has been found inoperative.

2. Several trucks were found to be in bad condition. As previously pointed out, it takes longer to handle a defective truck and, in addition to increased labor cost, defective trucks increase spoilage and when nails project from their sides, as was the case in Dept. 2, they increase the accident hazard.

3. Above aninspection table in the northwest corner of the department, an electric bulb was out. The Committee was told it had been out three days. The foreman stated that he had issued a Maintenance Request for replacement on November 9th. We recommend greater speed.

Rated on Equipment 80%

MATERIAL:

1. Left-over parts which were two days old were near machine #1622, not having been moved into the Left-Over space* as required by Bulletin 4671.

2. Machine #463 was idle because waiting for material.

3. Chas. Ramey was filing his own soldering coppers, contrary to present standard practice which provides that all coppers shall be forged and filed by the official Forger and Filer.

4. Material Tag #1863, dated November 1, was found on dust pan handles in the department on November 12th. Rules require that material be ordered not more than two days before needed. Presence of this material in department meant that it was ordered too early or delivered too late. Investigation is recommended.

Rated on Material 75%

PERSONAL PROPERTY:

1. Several milk bottles were scattered about.
2. Lunch refuse was found in scrap can.
3. Two coats were hanging in working areas.
4. Six pairs shoes were on floor.

Rated on Personal Property 90%

Departmental Rating 81-2/3%

F.W. Condon

Chairman, Conditions Audit Committee

6 After the audit was finished on Nov. 12th, the committee chairman dictated the committee's detailed report. Two copies of this typewritten report were sent to the supt. For the first copy see F. For the second copy see diagram 3, H.

FOLLOW THE ARROWS

The illustrations on these two pages and the page following show the paperwork necessary in making the Conditions Audit and following through on the committee's recommendations.

To understand how the audit plan worked, start at (1), read the note in the adjacent shaded panel, follow the arrows to Exhibit A—the committee's notes and recommendations.

Successive numbered panels and lettered exhibits show what happened to each of the recommendations.

For a complete description of the plan, turn back to page 281

* See "How Left Overs Can Be Controlled" by H. E. Boyd in Industrial Management, May, 1927.

THE CONDITIONS AUDIT

DIAGRAM ③

Upon receipt of report from the conditions audit committee the supt. dictated a covering letter (see J). The superintendent's secretary cut up the second copy of the report and pasted on the covering letter (J) the portion of the report that referred to Dept. 2. This copy of the report with the attached covering letter was sent to the foreman of Dept. 2, who after correcting conditions, wrote on the copy of the report exactly what he had done and returned it, with his notations to the supt. See H.

7

After reading the foreman's explanation of the machine idleness, the supt. wrote to the foreman and reminded him of his failure to inspect material. See letter K

8

The supt. also asked the general storekeeper to explain delivery of wrong material. See letter L.

9

Act Promptly and Be Brief

INTER-OFFICE MESSAGE

Date November 14, 19---

To: Foreman, Dept. 2.

From: Superintendent, Plant #12

Subject: Conditions Audit for November, 19---

Reference:

ROUTING

Name | Comply | Initial

You will find attached a copy of the report of the Conditions Audit Committee covering non-standard conditions found in your department on November 12th.

Please bring all reported non-standard conditions up to standard, note in writing on the attached copy of the report exactly what you have done, and return it to me not later than close of business Monday, November 19th.

J. G. Blaine
Supt., Plant #12

J

Dept. 2:

Equipment:

1. The Benjamin Safety Device on machine #1646 was tied down notwithstanding the loss of Tim McGovern's three fingers in Dept. 63 last week, which happened when McGovern disobeyed rules and tied down his safety device in order, as he thought, to increase production. This is the third time in the last 16 months that a safety device in Dept. 2 has been found inoperative.

2. Several trucks were found to be in bad condition. As previously pointed out, it takes longer to handle a defective truck and, in addition to increased labor cost, defective trucks increase spoilage and when nails project from their sides, as was the case in Dept. 2, they increase the accident hazard.

3. Above an inspection table in the northwest corner of the department, an electric bulb was out. The Committee was told it had been out three days. The foreman stated that he had issued a Maintenance Request for replacement on November 9th. We recommend greater speed.

Rated on Equipment 80%

MATERIAL:

1. Left-over parts which were two days old were near machine #1622, not having been moved into the Left-Over space as required by Bulletin 4671.

2. Machine #463 was idle because waiting for material.

3. Chas. Ramey was filing his own soldering coppers contrary to present standard practice which provides that all coppers shall be forged and filed by the official Forger and Filer.

4. Material Tag #1863, dated November 1, was found on dust pan handles in the department on November 12th. Rules require that material be ordered not more than two days before needed. Presence of this material in department meant that it was ordered too early or delivered too late. Investigation is recommended.

Rated on Material 75%

PERSONAL PROPERTY:

1. Several milk bottles were scattered about.
2. Lunch refuse was found in scrap can.
3. Two coats were hanging in working areas.
4. Six pairs shoes were on floor.

Rated on Personal Property 90%

Departmental Rating 81-2/3%

Act Promptly and Be Brief

INTER-OFFICE MESSAGE

Date November 20,----

To: Foreman, Dept. #2

From: Supt., Plant #12.

Subject: Wrong Delivery by Storeroom #9:

Reference:

ROUTING

Name | Comply | Initial

The Conditions Audit made November 12th reports that machine #463 was idle because of lack of material. You state that stock room #9 sent wrong blanks which was not discovered until machine was ready to start work. You are familiar with the rule which requires that the Foreman shall inspect each lot of material and the machine and tool or tools, if any, which are to work on it at least two hours before that work is to start. Was the inspection made on time and, if it was, why was the machine still idle three hours?

J. G. Blaine
Supt., Plant #12.

K

Act Promptly and Be Brief

INTER-OFFICE MESSAGE

Date November 20,---

To: General Storekeeper

From: Supt., Plant #12

Subject: Wrong Delivery by Storeroom #9:

Reference:

ROUTING

Name | Comply | Initial

On November 11th, wrong blanks were delivered to Machine #463, Dept. #2, on order 4964, which caused the machine to be idle three hours. Mistakes will happen, of course, but I recommend you have this error looked into and if it was caused or assisted by any inefficiency of the Planning Dept. or Dept. #2, I want to know about it.

J. G. Blaine
Supt., Plant #12.

L

Act Promptly and Be Brief

INTER-OFFICE MESSAGE

Date November 20,----

To: Foreman, Dept. #2

From: Supt., Plant #12

Subject: Forging and Filing Coppers

Reference:

ROUTING

Name | Comply | Initial

The Conditions Audit made November 12th reports Chas. Ramey was found filing his own coppers. You excuse this for the reason that Ramey was once the Forger and Filer and knows how.

A competent Forger and Filer is provided and it was understood that all forging and filing would be done by him. No exception should be made in favor of Ramey or any other.

J. G. Blaine
Supt., Plant #12.

M

After reading the foreman's excuse for allowing a workman to file his own coppers, the supt. instructed him to make no exceptions to plant rule. See letter M.

10

Modernization Money

FHA insured loans, direct loans by RFC and Federal Reserve Banks—offer three methods by which industry can get money to modernize

LEWIS K. URQUHART
Associate Editor

"1935 is building maintenance year," said *Factory's* leading editorial in April (page 141), and told *why*. A special section of that issue went into all the details of what to do, how to do it, and what to do it with.

Where to get the money?

Factory had the answer to that.

"Have you tried the RFC?" it asked. And proceeded in May (page 206) to point out the things plant operating men needed to know about the Act of Congress that gave wider discretion to the Reconstruction Finance Corporation's activities and expressly included plant rehabilitation among the purposes to which its loans could be applied.

That was news. *Here is more news.*

On May 28, 1935 the National Housing Act was amended to include—we quote directly from Regulation No. 24 of Title I as it now reads—"an advance of credit in excess of $2,000 but not in excess of $50,000 for the purpose of (1) repair, alteration, or improvement of real property already improved by, or to be converted into . . . manufacturing or industrial plants, or (2) the purchase and installation, in connection with the foregoing types of property, of such equipment and machinery, with or without any structural changes in the buildings, as are peculiarly adapted to the business conducted therein or necessary to the operation thereof."

FHA Had $200,000,000

To refresh your memory, the Federal Housing Administration originally had $200,000,000 with which to insure the makers of home modernization loans up to 20 per cent. Loans were limited to a maximum of $2,000, and FHA had underwritten $85,000,000 (as of June 15) of advances for home and small property rehabilitation, had therefore used up less than $20,000,000 of its appropriation.

Balance, about $180,000,000.

Remembering that FHA's function is to insure the lender against

loss up to 20 per cent of his loans, *the remaining $180,000,000 will provide insurance for $900,000,000 of additional loans.*

It all boils down to an opportunity for you or your company to borrow the money needed to get your plant ready for the job directly ahead.

Factory has so often said:

"This industrial nation of ours must *make* in order to *have*. What it makes must be produced at the lowest possible cost in order that the greatest number of people may share. To make its products at low cost, industry must take full advantage of technological developments in methods and equipment. And in this procedure it must not fail to deal fairly with its workers and its stockholders."

To make its products at low cost, industry must take full advantage of technological developments.

This is your chance.

Don't worry about the red tape. There is scarcely any. Walk into a bank with the "house in a circle" sign, which means it has qualified to get FHA insurance, and make your application in the usual way. Terms are up to you and the bank, except that the loan must be payable in monthly installments, pay out in 5 years, carry an interest charge not exceeding the equivalent of a $5 discount per $100 face amount of a 1-year note payable in monthly installments.

The bank then turns around, if it wants to protect itself up to 20 per cent, and sends your financial statement to FHA, which will approve any reasonable credit risk for an expenditure for machinery and equipment—and for building maintenance, of course—that will make your property more useful for the purpose originally intended.

Gone, incidentally, is the old requirement that the annual obligation under a modernization loan shall not exceed 20 per cent of the borrower's annual income (which previously applied to home modernization loans), but it may be applied in the discretion of the lending institution.

What You Can and Cannot Buy

Interpretation of the words "for machinery and equipment" is to be broad, will be left largely up to the banks. No list of eligible items will be prepared, but rulings in individual cases may be had.

Mobile or portable equipment is technically out. However, it may actually be included as part of a large specification without question. A connection by wire, tube, hose, flue, is considered attachment.

Machine tools, production machinery, processing equipment, conveyors, motors, power generating equipment, mechanical power transmissions, air conditioning equipment—practically anything else your plant needs—are in.

One thing more. You needn't stop at one loan. The $50,000 limitation applies only to one property. We quote Regulation 25:

Questions You'll Be Asking About FHA Loans and Answers to Them

Can you borrow? **Yes. Any industrial concern whose credit is good can borrow.**

How much? **Maximum, $50,000 on any one piece of property. Number of loans limited only by your credit.**

Who passes on you as a credit risk? **The lending bank.**

Is collateral required? **To be arranged between you and your bank. FHA accepts the bank's judgment.**

Endorsers? **No.**

Who makes the loan? **Any lending institution accredited by FHA. Look for house-in-circle sign.**

Where does FHA come in? **It will insure lender against loss up to 20 per cent of loan.**

What is total amount available? **FHA has $180,000,000 left, can therefore insure loans totaling $900,000,000. However, Act is likely to be extended, if industry makes use of facilities. Additional loans probably will be made without insurance.**

How long will money be available for insuring loans made by banks? **Until April 1, 1936.**

How do you pay? **In equal monthly installments spread over a period of not more than 5 years.**

What rate of interest? **Not exceeding equivalent of a $5 discount per $100 face amount of a 1-year note payable in monthly installments. This actually amounts to 9.716 per cent, which the experts say is a satisfactorily low rate for borrowing.**

What can you buy? **Machine tools, production machinery, power generation equipment, conveyors—almost anything that's fastened down.**

What can't you buy? **Mobile or portable equipment. (Even this may get in under certain conditions.)**

May you spend the money for building maintenance? **Yes.**

Who says what you can or can't buy? **The lending bank.**

Will FHA list approved items? **No. But it will make rulings in individual cases when necessary.**

Is there any red tape? **Less than half what you'd expect.**

"Where an advance of credit is for any of the purposes set forth in Regulation No. 24, any number of notes may be executed in connection with any number of pieces of property, but not more than $50,000 may be expended on any one piece of property."

Which means, as long as your credit is good you may borrow on a dozen pieces of property—if you have them.

So much for FHA, which does not make direct loans to industry, but merely insures such loans made by accredited lending institutions and thereby stimulates the release of credit for modernization purposes.

Direct loans to industry *are* being made, however, by the RFC and the Federal Reserve Banks.

How to go about getting an RFC loan was told in the May (page 206) article already referred to. Primary intent of such loans has been, still is, to maintain and increase employment, although the original limitation that they be used to pay for labor and material incident to the operation of a business has been partially removed to cover plant rehabilitation and more machinery.

As to Federal Reserve loans to industry, Section 13(b) of the Act authorizes Federal Reserve Banks to:

1. Discount for or purchase from any bank or other financing institution obligations entered into for the purpose of obtaining *working capital* for periods of 5 years or less.

2. Make loans or advances to banks and other financing institutions on the security of such obligations.

3. Make direct loans to or purchase obligations of such businesses, in exceptional circumstances, when it appears that requisite financial assistance cannot be obtained on a reasonable basis from the usual sources.

4. Execute commitments with respect to the foregoing.

Which, in plainer language, means that bankers may make loans to furnish working capital on long terms and at the same time obtain the promise of the Federal Reserve Bank to take over the loan at any time without recourse for 80 per cent of it.

It Works Out Like This

Typical Federal Reserve loan: Varnish manufacturer needed $25,000 working capital for a longer time than his local bank cared to lend without provision for liquidity. The local bank made an application to the Federal Reserve Bank for a commitment, which, after investigation of the business and the security, was approved. A loan of $25,000 was then made by the local bank repayable in equal semi-annual installments, the last of them due in four years. Security comprised a lien on plant and equipment, assignment of two life insurance policies and stock in another corporation. Loan bore interest at 6 per cent.

Covering the loan the Federal Reserve Bank gave the local bank a commitment to take over the loan any time within twelve months, for which commitment the local bank paid 1 per cent. Before the end of the twelve months it can either procure a commitment for a further period, or ask the Federal Reserve Bank to take the loan off its hands. The local bank is thus enabled to hold a loan whose liquidity is assured, on which its part of the loss may not exceed 20 per cent, and on which it receives 5 per cent net.

With FHA insured loans, direct loans by RFC, and loans protected by Federal Reserve Banks, 1935 should truly be Plant Modernization Year.

Courting Labor Trouble?

Of course not. Then don't attempt time and motion study unless the men you put on the firing line really know what they're doing

H. P. DUTTON
Associate Editor

THERE is appearing a brisk trickle of demand for time-study men, a demand likely to swell to considerable volume as rate structures, neglected during the depression, undergo the inevitable overhauling from top to bottom. *The rate offered by one firm for such men is 47 cents per hour.*

This task of rate revision must be carried on during a period in which there is every possibility of labor unrest. *It is no job for an amateur.*

Motion-study technique, developed by Taylor, the Gilbreths and Mogensen, may properly be ranked among the major inventions of the age. But, like labor-saving inventions generally, its immediate effect is to abolish jobs. Except in moments of national hysteria we all realize that the elimination of waste, whether by machinery or by motion study, must go on. But it should be done at the least cost in human displacement; if industry does not find ways to minimize the shock, society will. Again, *it is no job for an inexperienced youth.*

. . . one unfortunate workman had his job restudied and his rate reset three times in as many months

Most manufacturers like to feel that the workman gets a share in the savings he helps to make, and like to believe that, after they have set an incentive which accomplishes this result, they will not cut it. But the plain fact is that a manufacturer cannot indefinitely afford to pay more for a job when he can get others to do it for less. If he did, he would eventually find that competitors who had imitated his method without copying the bonus, would undercut him. It is an economic law that the benefits of improved methods go eventually to the consumer. Labor has benefited immensely as a consumer, probably more than any other class; even the work-relief client may today ride to his job. But, as regards the level of his money wages, the workman all too often finds, if he has an eye for comparison, that while, like the squirrel in his cage, he has constantly been climbing, as regards his earnings he is about where he was before.

Don't Pay Buyers 47 Cents an Hour

The workman does have an eye for such comparisons. Recent careful studies indicate that output restriction is almost as common as it ever was. It would be better for employers to stop kidding themselves on this point. The rate setter is a buyer of labor who is compelled by competition to buy closely, yet who must deal fairly so that he may deal with the same seller for years at a time. For such negotiations, for the average company's largest single purchase, *it is not good business to employ buyers at 47 cents an hour.*

It is a curious fact that for many years the buying aspect of time study was the only one that caught the imagination of industry. Men dismissed the study of motions to eliminate waste as an impracticable refinement, while they seized on the stopwatch and the impressive, often pseudo-scientific, ritual of time study as a new and effective weapon in the old, old guessing game of rate setting.

Perhaps the boss has read how Mr. A cut his labor costs in half. With no conception whatever of the real purpose of the work, he proceeds to hire a journeyman rate setter with notions equally primitive, and sets up a department which exists by its ability to show "savings" greater than its own expenses.

Next step is to pick out a couple of promising clerks, equip them with stopwatches and an air of authority, send them out into the shop. Such men cannot of course do much in the way of improving operations, a job calling for a highly developed technique. There is only one source, under such circumstances, from which "savings" can came.

It is reported that, due to layoffs and consequent concentration of the raw material available for time studies, one unfortunate workman had his job restudied and his rate reset three times in as many months. All, of course, with no more than a face-saving gesture in the way of improvement in method. Could a greater destroyer of morale be found than such stupid tinkering with men's bread-and-butter?

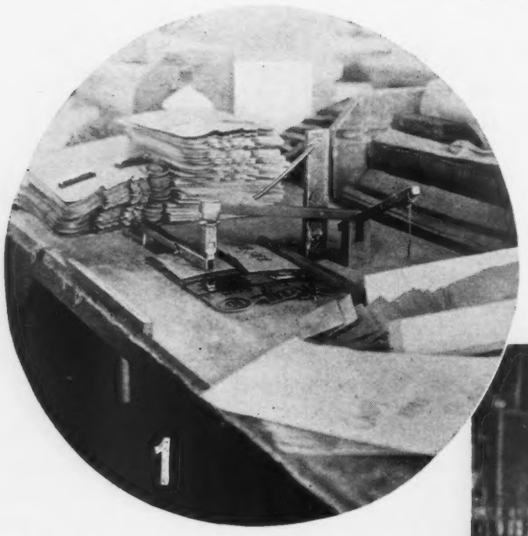
One company is deferring all rate setting for an indefinite period. Meanwhile, an intensive and intelligent job of motion analysis and waste elimination is being done. No incentive is offered for output, but a couple of general raises have been possible, and the men are in the mood to go places. This work is *not* being done by time-study men at 47 cents an hour.

There is of course a place for beginners in this work, as in any field. But the firm that buys its time study on a price basis is not only overlooking the real opportunities for profits in this work. In today's conditions it is also courting trouble.

Position Is Everything

Motion economy no respecter of plants. Principles that work in big plants work in little ones

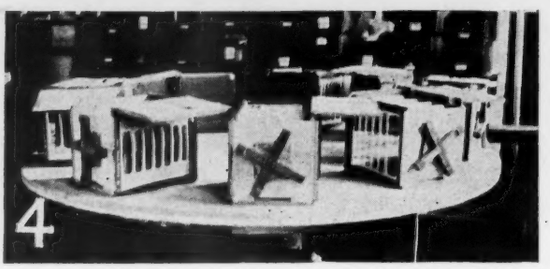
WILLIAM R. MULLEE
Standards Department
American Hard Rubber Company
Butler, N. J.



1 Stapling comb envelopes on cards. Hand-operated stapler converted into foot-operated device to reduce fatigue and save time. Guide to pre-position card so staples and envelopes will line up. No need to position each time by hand

2 Threading syringe pistons. Brackets attached to lathe to pre-position standard tote pans. Pedal resets collapsible die head. Funnel-shaped guide locates pieces, eliminating "position" therblig

3 Drilling caps. Pieces fed from hoppers. While drilling two, operator pushes next two with fingers. As drill releases, pieces are fed forward and drilled. Old way (one at a time), 0.045; new, 0.030. Saving, 33 per cent



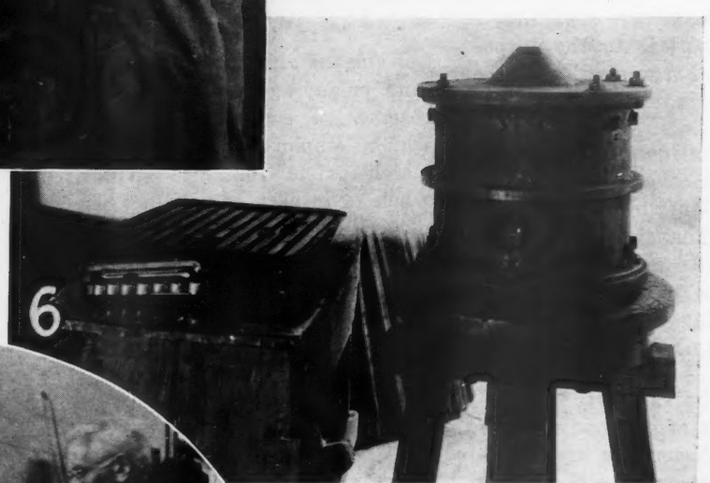
4 Assembling comb cabinets. A study of motion sequence resulted in 50 per cent production increase. Twenty kinds of combs are filed in compartments. Three display cards for each cabinet. Total, 126 combs. Stock is kept in boxes in background. Revolving table reduced walking.

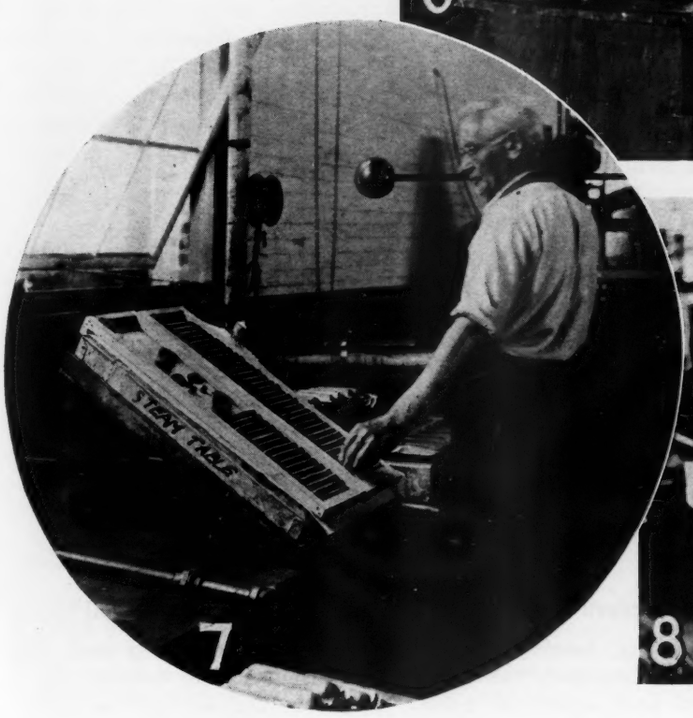
5 Shearing strips. Once a two-man job, one feeding, the other shearing. Shear now equipped with air cylinder operated with left hand. Right hand operates manual feed. Result, quicker and safer job. Old standard (two men), 0.540; new (one man), 0.385. Saving, 29 per cent

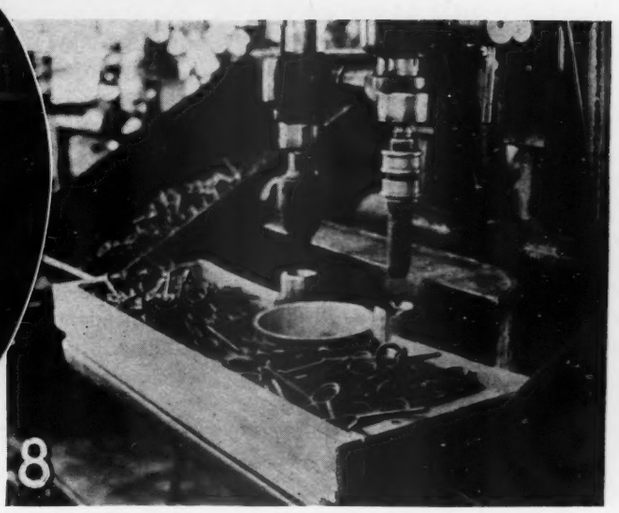
6 Bolt rack placed over pan of oil so bolts can be automatically lubricated as mold is opened and bolts are placed aside. By keeping bolts in rotation, they can be put back into the same holes. Wrench has interchangeable sockets to fit all sizes

7 Gravity feed. Formerly stock had to be constantly turned by hand to prevent overheating on steam table. This motion-economized steam table is set up on an incline. When a piece of stock is removed from the bottom, all the others roll down, making a complete turn every three pieces

8 Reaming. First, pre-positioned racks for tote pans. Second, drop delivery. Third, duplicate work stations and fixtures for simultaneous use of both hands. Old way, 0.03; new way, 0.025. Saving in time, 17 per cent







The Labor Act

Based mainly on regulation of interstate commerce. Courts may not uphold

WHAT are the objectives?

To guarantee to labor the right to organize as it chooses and bargain collectively; to prohibit employers from engaging in what the act terms "unfair labor practices."

What are these "unfair labor practices"?

Interfering with, restraining, or coercing employees in the exercise of: Self-organization; forming, joining, or assisting labor organizations; bargaining collectively through representatives of their own choosing; engaging in concerted activities, for the purpose of collective bargaining or other mutual aid or protection.

Dominating or interfering with the formation or administration of any labor organization; or contributing financial or other support to it. (An employer may permit employees to confer with him during working hours without loss of time or pay.)

Discriminating in regard to hire or tenure of employment to encourage or discourage membership in any labor organization. (Employer may make an agreement with a labor organization to require membership therein as a condition of employment, if that organization represents a majority of his employees.)

To discharge or otherwise discriminate against an employee because he has filed charges or given testimony under the Act.

To refuse to bargain collectively with the representatives of his employees.

What is a unit of employees?

The National Labor Relations Board decides whether the unit shall be employer unit, craft unit, plant unit, or subdivision thereof.

Who are the employees' representatives?

People designated or selected by the *majority* of the employees in a unit are to be the *exclusive* representatives. The term "representatives" includes any individual or labor organization. (Any employee or group of employees has the right to present grievances to employer.)

What is a labor organization?

"The term 'labor organization' means any organization of any kind, or any agency or employee representation committee or plan, in which employees participate and which exists for the purpose, in whole or in part, of dealing with employers concerning grievances, labor disputes, wages, rates of pay, hours of employment, or conditions of work."

What is the National Labor Relations Board?

A board created by the Act. It has three members, appointed by the President. It is empowered "to prevent any person from engaging in any unfair labor practice affecting commerce," to hold hearings, determine facts, and hold elections among employees in cases of dispute as to choice of representatives for collective bargaining. It has the power to issue "cease and desist" orders, orders to take affirmative action, and orders of dismissal. The Board is independent of the Department of Labor.

How are its orders enforced?

By appeal court procedure, if necessary. Employers can go to court, try to have orders set aside.

What workers are concerned?

Any employee, including "any individual whose work has ceased as a consequence of, or in connection with, any current labor dispute or because of any unfair labor practice, and who has not obtained any other regular and substantially equivalent employment." Exempted from the Act are individuals employed as agricultural laborers, in domestic service, or by parent or spouse.

How about employees of strictly intra-state enterprises?

The Act declares the policy of eliminating the causes of certain substantial obstructions to the free flow of interstate and foreign commerce; but also uses the term "affecting commerce," which the act defines as "in commerce, or burdening or obstructing commerce or the free flow of commerce, or having led or tending to lead to a labor dispute burdening or obstructing commerce or the free flow of commerce." Definition of "commerce" apparently limits it to interstate, which indicates Act cannot be applied to practices of purely local significance.

Does Act impose closed shop?

It legalizes closed-shop agreements, obviously affords strong support to the closed-shop ambitions of organized labor by "permitting" an employer to make a closed-shop agreement, with a labor organization representing a majority of his employees.

Are "employee representation plans" barred?

Legally no, in effect yes, because it is deemed an unfair labor practice for an employer to "dominate or interfere with the formation or administration of any labor organization or contribute financial or other support to it" (except pay employees for conferring during working hours).

Is the Act constitutional?

Its sponsors say yes. Many industrialists and lawyers say no. Look for Supreme Court decision.

Silicosis—Industrial Enemy

Dust particles that cause it are too small to see, never too small to stop. The hazard can be removed, compensation claims avoided

C. O. SAPPINGTON, M.D., DR. P.H.
Consulting Industrial Hygienist
Chicago

SILICOSIS is not a new disease, but American manufacturers and the public in general have become aware of its existence only within the past few years.

Simply defined, it is a disease of the lungs in which there is a general replacement of the normal elastic tissue by unyielding, inelastic, fibrous tissue. This occurs in a form that is known technically as nodulations, and shows a characteristic structure and distribution. The disease process is caused by the continuous breathing of microscopic particles of free silica dust for an extended period of time, usually years. As a result of the fibrous tissue replacement, there is shortness of breath, decrease in lung expansion, and an increased tendency to tuberculosis, although these symptoms also occur in other diseased conditions.

Silicosis is solely an occupational disease, although there have been rare instances reported in which the exposure was not occupational.

Nature has wisely provided primary and secondary lines of defense for the specific purpose of dealing with inhaled dust particles. The first line is composed of the hairs on the inside of the nose; the mucous secretion that moistens the surface of the lining of the nose, throat, and windpipe; and the so-called cilia or miscroscopic hairs protruding from the lining of these passageways. These hairs wave like a field of grain in the wind, propel microscopic particles of dust toward the outside, and aid in the expulsion processes of coughing, expectoration, or blowing the nose.

The second line of protection is more complicated and consists of the so-called lymphatic system which acts as a waste disposal path for the lungs. This is accomplished with the aid of specially developed cells that take up foreign particles of any kind, and convey them to various points from which they are carried into the larger passages of the body. Finally, these impurities are thrown off through the regular channels. When these defenses fail, silicosis develops.

Photographs by courtesy of Metropolitan Life Insurance Company

Accurate measurement of number and size of dust particles can be made with this apparatus which takes air samples in measured quantities and impinges them onto the surface of a liquid. Particles can be counted under microscope; sizes measured from photomicrographs

Keep in Mind Four Things

Four vital factors of the industrial environment are involved in the production of silicosis:

1. *The concentration of the dust.* The amount of dust in the breathing atmosphere may be expressed in various ways, one of which is the number of particles per cubic foot of air. Methods for the measurement of this factor have been worked out by the U. S. Bureau of Mines and the U. S. Public Health Service in research studies conducted during the past fifteen years.

2. *The size of the dust particles.* This factor is expressed in terms of microns (one micron equals 1/25,000 inch). Size is important because it is generally agreed that particles under ten microns in greatest diameter are those capable of entering the microscopic air sacs of the lungs proper.

3. *Mineral composition of the dust.* This refers particularly to the so-called quartz content of inhaled dust, and is considered to be an important qualitative factor in the production of silicosis. It is usually expressed as the percentage of quartz contained in dust that may be inhaled.

4. *Length of occupational exposure.* May be variable in different instances, but must necessarily be related to the other factors to obtain a definition of the hazard that may exist.

In the recognition of silicosis, it is useful to consider several types of

By placing an exhaust on this swing-grinding operation this manufacturer will keep his shop clean, preserve his men's health, and avoid compensation claims

information—the physical conditions of the industrial plant, the processes and materials, the occupational duties of employees, the previous medical and occupational histories of employees, the measurement of the four exposure factors that have previously been mentioned, and the medical findings. The last include a thorough history and examination of the chest, with stereoscopic X-ray films.

When all observations have been completed and associated with medical records, a rating of the possible health hazards can be made by comparing the values found with predetermined standards. Since all types of dust do not produce silicosis, considerable care and judgment should be used in the proper evaluation of any given set of conditions.

Experience the Best Teacher

The efficacy of these measures will depend largely upon those who use them and skill and ability which they have developed through an experience which has included considerable study of slight deviations from the normal. In addition, the ability to distinguish silicosis from maladies that simulate it, is valuable.

The relative importance of these procedures in the detection of silicosis cannot be set down in terms of percentages. To those who have had the greatest experience in this line of work, it has been proven that, under different conditions, some will assume greater significance than others, and no adequate prediction may be made for any given problem. To get the best results it is wise to consider all methods of value.

As in all other occupational diseases, prevention is of paramount importance, and in this instance it partakes both of medical and engineering measures.

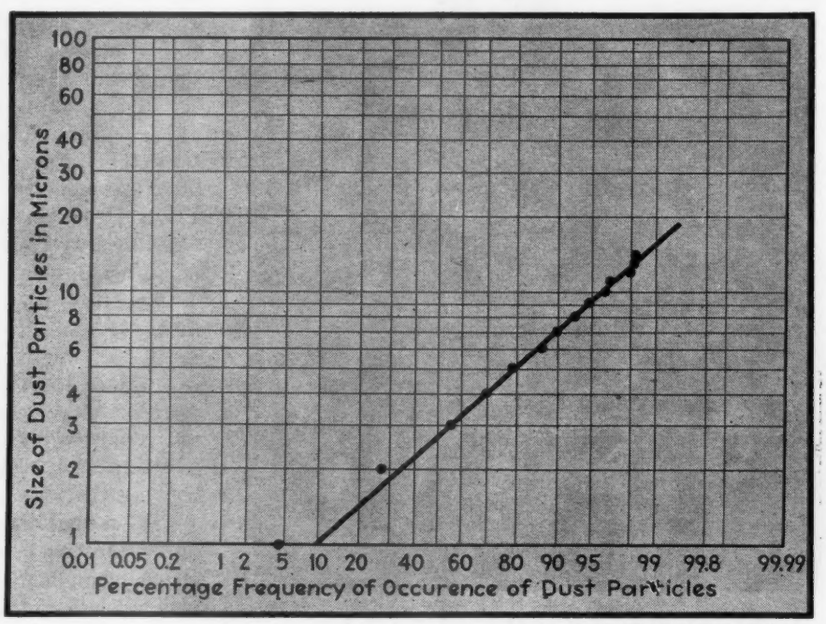
Among the medical steps are the pre-employment examinations with chest films, periodic examinations with chest films, and the intelligent placement of employees according to the results of these examinations.

Among the engineering measures of environmental control are the compilation of information about materials and processes through a physical survey of plant equipment and an occupational analysis; qualitative and quantitative dust analyses of the possible hazards; a rating of the efficiency of protective devices; and finally, the assembling of the information gained and comparison with established criteria.

Protection Is Possible

As means of protection, there are two general methods in use—personal protection of the individual employee, and control of the dust particles. Both of these procedures are now on a practical basis, but necessitate regular inspection and maintenance so that the devices will function properly. In the measurement of a hazard, one is not so much concerned with what the device takes out of the air as with what is left in the air and breathed by the exposed worker.

Silicosis is an important disease, industrially, socially, and economically. Steps taken in preventing it will be indicative of the progressiveness of any industry. Time, money, and effort wisely expended now can be expected to pay large dividends in the future.



Courtesy of The Journal of Industrial Hygiene

Dust particles must be less than ten microns in diameter to enter the lung tissue and cause silicosis, but the frequency of the minute particles is demonstrated by this composite graph which shows the results of analyses of general air samples taken from twelve foundries

Where Shop and School Meet

Gentlemen, we give you this apprentice training plan which effectively coordinates classroom theory and shop practice

L. Q. MOSS
In Charge of Related Instruction
Apprentice School, U. S. Navy Yard
Philadelphia

PRACTICE in the manipulative skills alone cannot train men to cope with the technical problems that modern crafts involve, nor can it be relied upon for continuous development of men qualified for supervisory positions. Such men cannot be made simply by aging them in a trade environment for a certain period of time. Job analyses have revealed that mechanics and foremen must possess technical knowledge and understanding undreamed of in the days of clipper ships.

Recognition of these facts led the Navy Department in 1912 to authorize the establishment of apprentice schools in each of its twelve yards.

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Regulations governing employment of civilian personnel in Navy Yard service specify an apprentice training period of four years—7,648 shop and school hours. The first year is probationary.

Working hours are eight per day, five days a week. Rate of pay is $14.40 per week for the first year, increasing by equal annual increments to $28.80. Apprentices earn pay at their regular rate while attending school. Tools, instruments, and books are lent them by the yard.

Schools Fit Needs

Each local yard must adapt apprentice regulations to its own special requirements. At Philadelphia, for instance, the apprentice system offers training in a large assortment of skilled trades in two major industries—shipbuilding and aircraft construction. The present enrollment of 115 apprentices is distributed according to the table on the following page.

Practical training is carried out in shops, drydocks, and hangars, according to regular training schedules for each trade. The schedule for apprentice electricians, for example, includes motor and generator testing, rewinding, repairing, 3 months; machine tool practice, 2 months; electric equipment and switchboard assembly and repair, 3 months; etc.

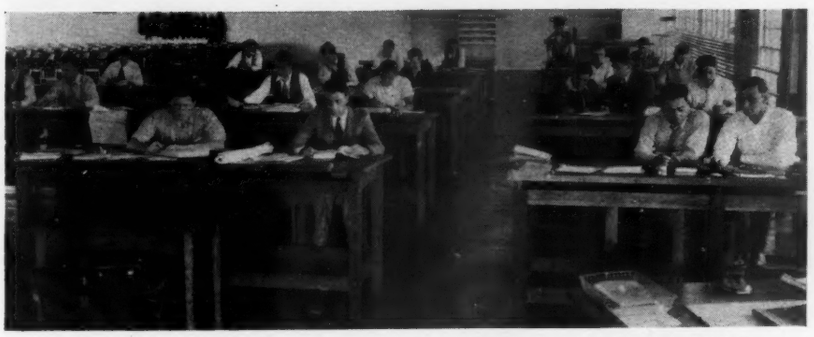
Proper coordination of theory and practice is the *sine qua non* of effective vocational training. Unless school instruction is closely correlated to shopwork, much of the value of this type of training is lost. The organization of courses so that the "academic" subject matter may function directly in the trade work of the learners is as difficult as it is important. Where the number of trades involved is large, the difficulties are multiplied.

Our school in Philadelphia presents an extreme case of this kind. Academic work must be differentiated for more than twenty trades in two major industries. Furthermore, the scholastic background of entering apprentices ranges from sixth grade to high school and beyond. Previous schooling is often totally unrelated to their new careers. Some enter without the fundamentals of mechanical drawing, mathematics beyond arithmetic, or shop experience of any kind. Others have pursued trade courses in high schools or technical institutes.

These factors were involved in the problem presented to the Philadelphia Board of Education about five years ago when the local Navy Yard authorities asked for assistance in the reorganization of their apprentice school. Inasmuch as its cooperation would improve this educational opportunity afforded to many young citizens of the community, the Board assigned a full-time instructor.

School Board Cooperates

Under this cooperative arrangement there has been developed a plan of instruction which may be readily adapted to the uses of private in-



In school work apprentices are grouped by trades—in this instance, shipfitters, sheet metal workers, and boiler makers. Correlation of the work in school and shop is attained by the project method. Instruction is on an individual basis. No formal classroom procedure. No recitations

By placing an exhaust on this swing-grinding operation this manufacturer will keep his shop clean, preserve his men's health, and avoid compensation claims

information—the physical conditions of the industrial plant, the processes and materials, the occupational duties of employees, the previous medical and occupational histories of employees, the measurement of the four exposure factors that have previously been mentioned, and the medical findings. The last include a thorough history and examination of the chest, with stereoscopic X-ray films.

When all observations have been completed and associated with medical records, a rating of the possible health hazards can be made by comparing the values found with predetermined standards. Since all types of dust do not produce silicosis, considerable care and judgment should be used in the proper evaluation of any given set of conditions.

Experience the Best Teacher

The efficacy of these measures will depend largely upon those who use them and skill and ability which they have developed through an experience which has included considerable study of slight deviations from the normal. In addition, the ability to distinguish silicosis from maladies that simulate it, is valuable.

The relative importance of these procedures in the detection of silicosis cannot be set down in terms of percentages. To those who have had the greatest experience in this line of work, it has been proven that, under different conditions, some will assume greater significance than others, and no adequate prediction may be made for any given problem. To get the best results it is wise to consider all methods of value.

As in all other occupational diseases, prevention is of paramount importance, and in this instance it partakes both of medical and engineering measures.

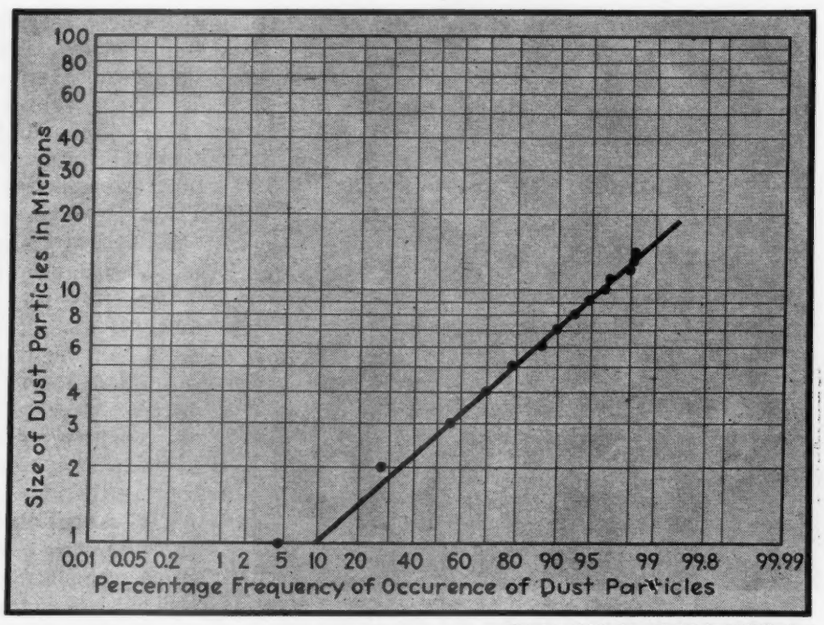
Among the medical steps are the pre-employment examinations with chest films, periodic examinations with chest films, and the intelligent placement of employees according to the results of these examinations.

Among the engineering measures of environmental control are the compilation of information about materials and processes through a physical survey of plant equipment and an occupational analysis; qualitative and quantitative dust analyses of the possible hazards; a rating of the efficiency of protective devices; and finally, the assembling of the information gained and comparison with established criteria.

Protection Is Possible

As means of protection, there are two general methods in use—personal protection of the individual employee, and control of the dust particles. Both of these procedures are now on a practical basis, but necessitate regular inspection and maintenance so that the devices will function properly. In the measurement of a hazard, one is not so much concerned with what the device takes out of the air as with what is left in the air and breathed by the exposed worker.

Silicosis is an important disease, industrially, socially, and economically. Steps taken in preventing it will be indicative of the progressiveness of any industry. Time, money, and effort wisely expended now can be expected to pay large dividends in the future.



Courtesy of The Journal of Industrial Hygiene

Dust particles must be less than ten microns in diameter to enter the lung tissue and cause silicosis, but the frequency of the minute particles is demonstrated by this composite graph which shows the results of analyses of general air samples taken from twelve foundries

Where Shop and School Meet

Gentlemen, we give you this apprentice training plan which effectively coordinates classroom theory and shop practice

L. Q. MOSS
In Charge of Related Instruction
Apprentice School, U. S. Navy Yard
Philadelphia

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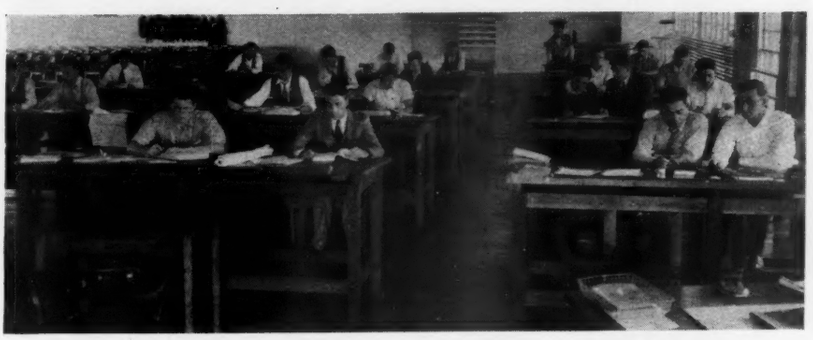

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Distribution of Apprentices
U. S. Navy Yard, Philadelphia

SHIPBUILDING

Blacksmith	2	Painter	2
Boat Builder	2	Pattern Maker	2
Boiler Maker	4	Pipefitter	4
Coppersmith	4	Plumber	1
Electrician	19	Sailmaker	1
Joiner	2	Sheet Metal Worker	8
Machinist	22	Shipfitter	14
Molder	2	Shipwright	2

AIRCRAFT CONSTRUCTION

Airplane Mechanic (General)	5	Joiner	0
Airplane Mechanic (Motor)	5	Machinist	6
Boat Builder	1	Pattern Maker	1
Painter	1	Sheet Metal Worker	5

dustrial plants that either have apprentice training programs or contemplate having them.

The plan provides for grouping apprentices according to trades. Trades that do not have enough apprentices to form a separate class are grouped with apprentices in trades most nearly allied to their own. Each group attends school one day a week for the required six hours. This arrangement facilitates the assignment of draftsmen from the several divisions of the Yard Drafting Department to part-time instruction of apprentices in blueprint reading, sketching, layout work, and other drawing techniques connected with their trades.

Correlation of the work in school and shop is attained by the project method. The school staff in cooperation with the shops develops technical projects around actual work situations in each craft.

The Project Method

Shipfitters, for example, lay out shell plates from blueprints of ships' molded lines; draw up the templets with proper markings for cutting, riveting, welding, etc.; calculate areas, weight, strength of plates. Shop reports, safety articles, technical descriptions, operation sheets, business letters are also included in the projects. Short courses in shop sketching and mechanical drawing, mathematics, physics, and English are taken as needed.

Similarly, the school work of machinists centers around problems of machine design; electricians, electrical control diagrams; aircraft motor mechanics, repair and adjustment of aircraft engines.

Comprehensive examinations in work of shop and school are required every six months. Shop examinations are constructed by the supervisors under whom the apprentices have been working and contain questions pertinent to the trade elements covered during the period. School examinations are drawn up by instructors to measure the apprentices' mastery of school work. Grades in examinations and daily work of shop and school are reported semi-annually to the Navy Yard Labor Board, and from these grades the Board makes its recommendations for promotion, retention at present rate, or discharge.

The apprentice school maintains contact with graduates, gives information concerning requirements for promotion and choice of courses for the continuance of their education. Graduates are rated as artisans in their particular trades. In most instances the entire graduating class is retained for duty in the Yard. The opportunities available to these former apprentices are constantly before them, for many of the foremen, supervisors, and heads of departments are themselves products of the school.

"Experience throughout the United States," says the Federal Board for Vocational Education, "has thoroughly established the fact that trade extension work for apprentices or other persons employed in industry is one of the most efficient and least expensive types of vocational education. . . . The best forms of part-time trade extension work have always been found where there is real cooperation between employers, employees, labor, and the public schools."

The entire apprentice training program in this Navy Yard seems to bear out that statement.

Practical training is carried out in shops, drydocks, and hangars, according to regular training schedules for more than a score of trades in two major industries—shipbuilding and aircraft construction. Here, for example, apprentice pattern makers learn how under actual shop conditions

Catch Labor Costs in the Act

Small plants can use this yardstick of efficiency on workers or on departments without sending clerical costs sky-high

F. K. ZIMMERMAN

Cost Accountant, The Aro Equipment Corporation
Bryan, Ohio

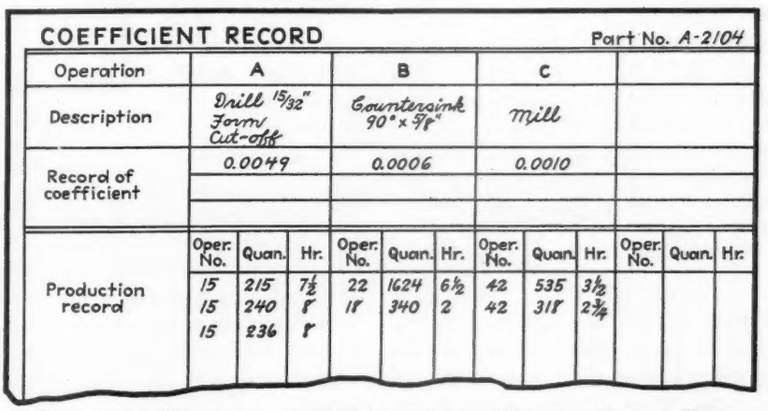
SMALL manufacturing concerns experience difficulty in maintaining a set-up that reflects the efficiency of various departments and of individual workers. The small volume of direct labor makes it impracticable to use the extensive cost and efficiency systems employed by larger concerns. Generally speaking, manufacturers employing from 50 to 200 men feel that efficiency must be maintained by the shop foremen and the superintendent, along with their other duties.

To provide a check on all productive laborers and to give the factory superintendent and the management a daily report on the efficiency of the factory, we have established a method whereby efficiency may be checked from day to day in the smaller plant at little expense in the way of overhead to the management. This plan is applicable to any small concern that manufactures a reasonably consistent line of goods throughout the year.

It has been found that issuing the rate of efficiency to the factory workers daily provides an incentive for reducing labor cost. This is true because advancements in position and increases in remuneration are naturally given to those who have proved most efficient. If the workers know that their efficiency is being watched, the incentive for greater speed, fewer errors, and less scrap is heightened. Some industries have also based bonuses upon an efficiency basis.

Keeping Direct Labor Costs Low

Daily efficiency reports also encourage non-productive laborers to cooperate more fully with productive workers in keeping direct labor costs at a minimum. Since truckers, clean-up men, storekeepers, etc., are paid at lower rates per hour than machine operators and assembly men, it is naturally more to the interest of management that the indirect laborer perform all non-productive tasks than to permit or force the productive worker to leave his machine and go to the stockroom for material or to truck his finished product to the proper location.



COEFFICIENT RECORD — Part No. A-2104

Operation	A			B			C					
Description	Drill 15/32" Form/ Cut-off			Countersink 90° x 5/8"			Mill					
Record of coefficient	0.0049			0.0006			0.0010					
Production record	Oper. No.	Quan.	Hr.	Oper. No.	Quan.	Hr.	Oper. No.	Quan.	Hr.	Oper. No.	Quan.	Hr.
	15	215	7½	22	1624	6½	42	535	3½			
	15	240	8	18	340	2	42	318	2¾			
	15	236	8									

Figure 1. Coefficients are recorded for each operation on each part. From them it is possible to find the daily efficiency figure of an individual worker or of the factory as a whole

The essential factor necessary for the development and working of this plan is a time-reporting method which supplies the following information:

1. Worker's clock number.
2. Daily production report of pieces run, part number, operation, and hours required to perform each operation.

This information is available in almost all small manufacturing concerns. The only equipment needed is a loose-leaf book and a calculating machine.

Analyzing Daily Report Cards

For the small plant that wants to adapt this plan to its own problem of controlling direct labor costs, the most recent period of normal operation should be selected upon which to base the efficiency standards. The daily report cards for this normal period should be analyzed in the following way:

1. Count the number of pieces run through each productive operation of that piece.
2. Count the number of hours required for each operation counted as above.

A typical analysis of this sort is shown in Table I, and a similar analysis should be made for each manufactured part. If past records are not available, a timestudy may be made of each operation, and the standard number of pieces per hour determined.

After such records are available for all parts, a coefficient for each

Table I—Analysis of Daily Report Cards

Part Number *A-2104*
Operation *A*

Pieces	*Time Required*
210	8 hours
95	4 "
136	5¾ "
66	3 "
230	8 "
235	8 "
195	8 "
50	2½ "
1,217	47¼ "

Operation *B*

Pieces	*Time Required*
250	1¾ hours
1,010	4½ "
1,260	6¼ "

operation on each part must be determined. The first step in this direction is to divide the number of pieces passing through each operation by the number of hours required to run them. The final step in finding the coefficient for each operation is to divide the reciprocal of the number of hours in the working day by the number of operations performed per hour.

For operation *A* on part A-2104 (see Table I), total pieces (1,217) divided by total hours (47.25) equals 25.76 pieces per hour. The factory works eight hours per day. The reciprocal of 8 is $\frac{1}{8}$, or 0.125. Hence the reciprocal (0.125) divided by number of pieces per hour (25.76) gives us 0.0049 as the coefficient.

Finding the Coefficient

A record of these coefficients (Figure 1) is made for each manufactured part. Space is allowed in the record to accumulate additional information as to time required for performing the various operations. Thus, when better machinery, improved tools, etc., make increased production per hour possible, a new coefficient may be found readily. If provision is made to record the clock number of the operator, it will also provide a record of which operators are capable of performing various operations most efficiently.

After a coefficient is determined for each operation of each part and is recorded in an accessible loose-leaf book, very little time is required to find the daily efficiency figure of individuals or of the factory as a whole.

For example, Figure 2 is a typical daily report card. To find this operator's efficiency for the day, multiply the number of pieces completed on each operation by the coefficient. The result is shown in Table II.

The digit *1* represents 100 per cent efficiency based upon past experience of the time required to do the day's work under normal operation. The operator, whose record for the day was 1.0202, produced slightly more than the average. When the efficiency figure for the day is less than *1*, the operator is not up to the average. An average for the department or for the factory as a whole may be determined by taking an average of the daily efficiency records of the productive workers in the particular department or in the entire factory.

If all coefficients are figured to the same number of decimal places, it is not necessary to write the efficiency each operation contributes and then add them as shown above. A calculator is used, and the products of each multiplication are allowed to accumulate for the final efficiency figure.

If there is idle time, the efficiency of the department as a whole will suffer in that no credit can be earned during that time. The same is true of time spent in non-productive work that should have been done by some worker hired for that purpose. Such inefficiencies, once ascertained, are investigated and corrected.

If upon investigation it is found that a worker was forced to remain idle or to do someone else's work due to poor management, he should not be required to bear the low efficiency figure himself. In such cases, when individual efficiency is recorded, 0.125 is added to the productive labor efficiency total for each hour the worker was *unavoidably* kept from productive work. It must be kept in mind, however, that such procedure is not employed when figuring departmental efficiency, nor when the worker himself is responsible.

Piece-rate workers may be measured as to efficiency on the same standard as day workers. It is important to management that machinery be used to its limit, that floor space be efficiently employed, etc. Overhead per piece is reduced through increased production on piecework jobs, even though productive labor cost per unit of product remains the same.

DAILY REPORT CARD

Worker's Number 52

Part No.	Operation	No. Completed	Hours	Pay
A-2104	A	58	$2\frac{1}{2}$	1.00
A-2104	B	400	2	.80
A-1634	A	216	$3\frac{1}{2}$	1.40
			8	3.20

Figure 2. To find this operator's efficiency for the day, multiply number of pieces completed on each operation by the coefficient

Table II—Computation of Daily Efficiency Figure

A-2104, Operation *A*:	58 pieces	× 0.0049	0.2812
A-2104, Operation *B*:	400 "	× 0.0006	0.2400
A-1634, Operation *A*:	216 "	× 0.0023	0.4968
Efficiency for the day			1.0210

Labor Shortage

SHORTAGE of 1,193 skilled craftsmen is reported by 287 metal manufacturing companies employing 115,260 wage earners, according to a National Industrial Conference Board study. In the metal-working industry as a whole the shortage is estimated at 19,034. Resumption of normal operations would increase the shortage to 123,357.

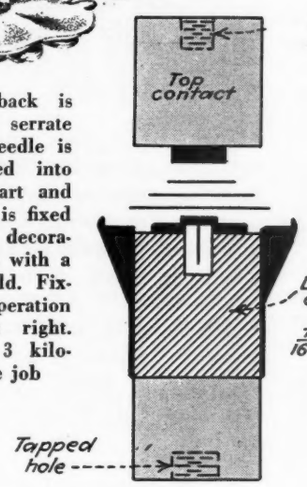
Factors in shortage: (1) Development of single-machine operators; (2) shift to other occupations; (3) deterioration of skill; (4) mortality of five per cent per year; (5) inadequate apprentice training; (6) reduction in working hours; (7) minimum wage restrictions; (8) fear of leaving relief roles; (9) attractiveness of wage scales on relief projects.

Remedies suggested by employers: (1) Abolition of code limitations; (2) changes in relief methods; (3) reduction of public works wage scales; (4) training of unemployed labor under work relief; (5) retraining of "skilled" workers; (6) improvement of automatic machine tools.

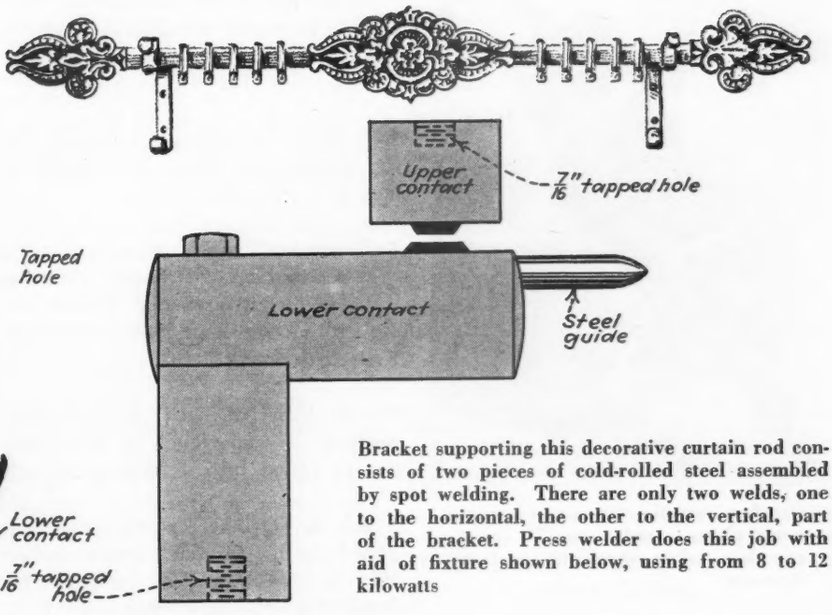
Cooperating employers agree that long-time solution lies in comprehensive and efficient apprentice training.

Spot Savings

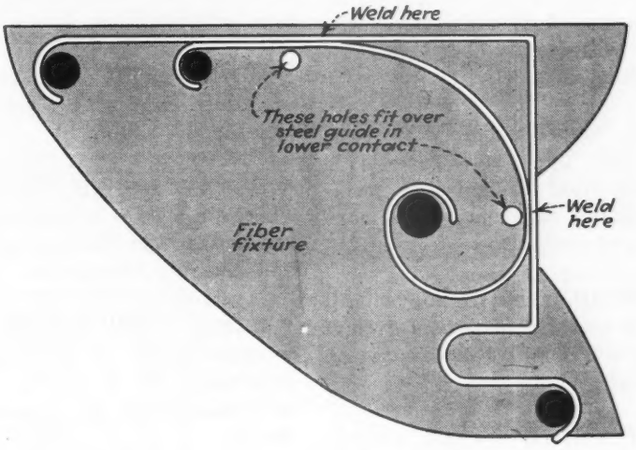
Welding, for certain types of assembly, can spot other methods a tidy number of dollars—and turn out a better product



Curtain holdback is made of five serrate parts. The needle is first assembled into the headed part and this assembly is fixed to the three decorative stampings with a single spot weld. Fixture for this operation is shown at right. Takes about 3 kilowatts to do the job



Bracket supporting this decorative curtain rod consists of two pieces of cold-rolled steel assembled by spot welding. There are only two welds, one to the horizontal, the other to the vertical, part of the bracket. Press welder does this job with aid of fixture shown below, using from 8 to 12 kilowatts



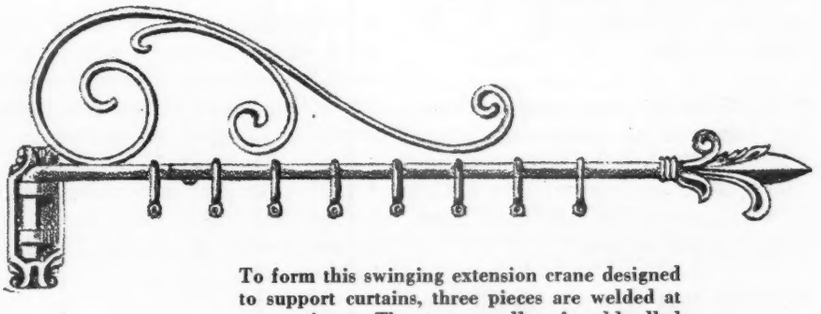
WELDING as a production tool is fast, adaptable, economical. Often it produces a better job at far less cost. Sometimes it is the only way of doing a job.

The Kenney Manufacturing Company, Cranston, R. I., uses welding to excellent advantage in the assembly of ornamental steel curtain rods, brackets, and holdbacks.

Production is in large quantities, but designs are constantly changing. Two automatic spot welders are used, weld as many as five pieces simultaneously. Some of the products could not be assembled by any other process, others would cost ten times as much if brazed or riveted.

Three samples are shown. Special fixtures adapt the welders to individual jobs, are so constructed that they can be changed quickly.

An important advantage of welding this type of product is that spot welds leave marks so small as to be quite inconspicuous after lacquering.



To form this swinging extension crane designed to support curtains, three pieces are welded at two points. The two scrolls of cold-rolled steel are welded first. Then the complete scroll is welded to the square hot-rolled steel bar. Power used is 15 to 18 kilowatts per weld

You Want To Know

. . . and the editors will gladly tell you . . . more about the things mentioned on this page

Grinder, portable, for use in hard-to-reach places, weighs only 15 ounces complete, takes wheels up to 1¼-in. diameter

• ECONOMIC LAW foredooms to failure every effort to benefit workers by wage and hour controls. New booklet tells why.

• WOOD impregnated with synthetic resin by a new process is highly resistant to moisture, abrasion, chipping, splitting; yet is more flexible and resilient.

• ALUMINUM and its alloys. All you need to know in the most comprehensive booklet we've seen yet on that metal.

• FAMILY of cartons idea, adopted for automotive parts, is at least partially responsible, they say, for increased sales.

• NUISANCE into profit. Prize for July won by mushroom grower who fertilized beds with manure, raised large numbers of flies. Now he refrigerates the flies, cans them, ships to frog raisers.

• FANS that draw the cool breezes of evening into the home, force hot air out of the attic, might be used to ventilate and cool that small plant.

• METERS for outside installations have to be protected against weather. Die-cast aluminum boxes provide just the container that's needed.

• X-RAY your product in motion on the production line. New machine makes it possible.

• PACKAGE of the month may be that of the olive oil concern offering its product in a special shaker designed so you can mix your own French dressing.

• VACATIONS with pay for wage earners — experience of 281 companies rolled into a 36-page report.

• BACK TO BAGS is what has happened to a famous firm's coffee. Bag is double-walled, keeps coffee fresh for 21 days (same as tin), accounts for 3-cent-a-pound reduction.

• MONOGRAPH on industrial lubrication—first of a series—can be had for the asking.

• PLANT need its "face lifted"? There's a special cement coating for renovating and damp-proofing brick and concrete structures.

• CABLE CONNECTOR for arc welders cannot be disconnected accidentally, yet is readily connected or disconnected by a twist of the wrist.

• SHORTER work week—a summary of the probable effects of a 30-hour limitation on employment, production costs, prices, purchasing power, and output per worker.

• NOW you can buy nickel-molybdenum steel (SAE 4650) socket and open-end wrenches at the 5 and 10. In three sizes.

• ALUMINUM tiles, enameled in range of light colors, are not supposed to craze, chip, or get loose.

• CUTTING FLUIDS, their influence on tool life in turning steel. Want an A.S.M.E. paper on this subject?

• SAND or buff ordinary phenolic molding materials and you uncover flecks of fibrous filler, most likely spoil the color. Hence a new compound for plastic parts that require machining and subsequent re-polishing. It can "take it."

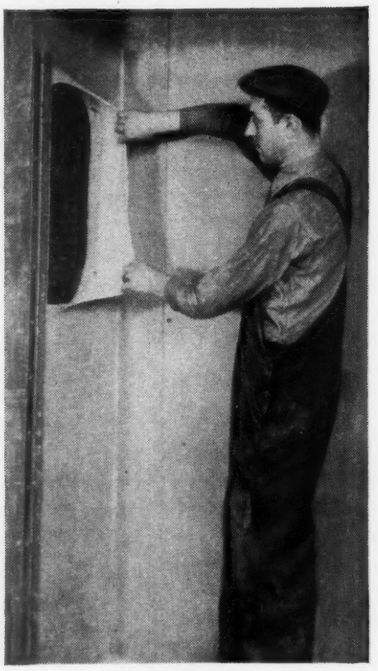
• LABOR, the irresponsibility of. Reprint of an Atlantic Monthly article is available.

• FIGURING machine has molded case, 10-key keyboard, weighs only 7 pounds, sells at popular price, is advertised for all kinds of adding or calculating work.

• COLORED valve wheels make it next to impossible for anyone to turn on the wrong valve. They come in five standard colors, either unmarked or with service markings molded in relief.

• MEGGER practice—free copy of a pocket manual is waiting for you to say the word. Comprehensive treatment of insulation resistance testing.

Rubber coating, used as masking compound in metal plating, as protection for painted surfaces during handling, etc., is applied by brushing, spraying, dipping; is readily removed after serving its purpose



OPERATING SHORTS

Reel and Trolley Keep Cable Clear

J. A. HONNEGER, *New York*

Along the assembly lines in many organizations, portable electric tools, such as drills and tappers, are employed. They may not be employed continuously but only for a short interval so that one set of portable tools may be used by a group of assemblers.

Under ordinary conditions, stationary feeder outlets are employed at suitable points along the line and the assembler plugs into the nearest one.

This was the condition that existed in a plant the writer had been engaged to revamp somewhat. On several occasions workmen were injured because the cables on the floor snaked them. Also there was at times a confusion of cables on the floor and the assemblers lost time unsnarling them.

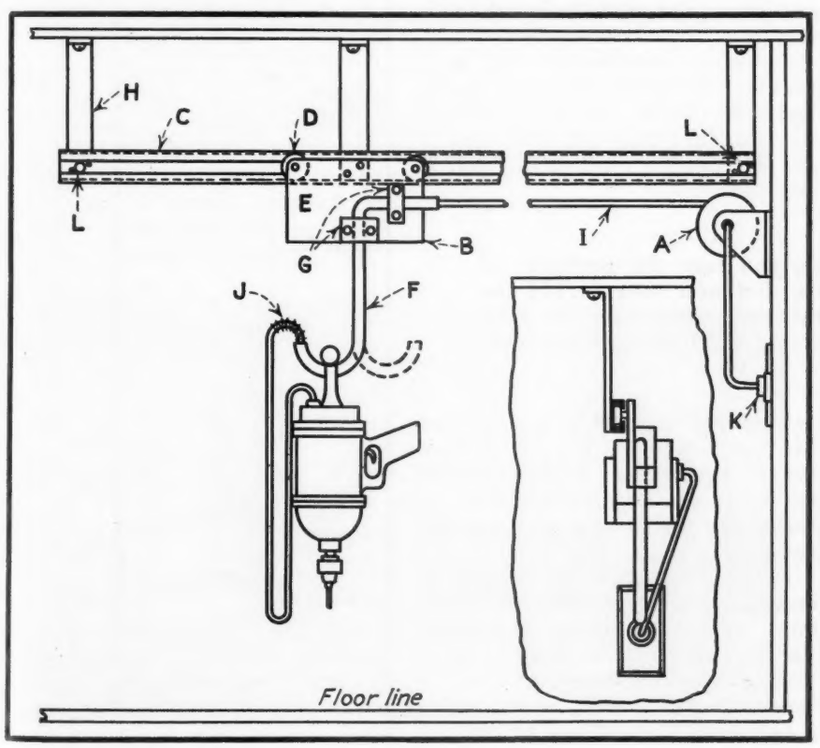
To eliminate all these drawbacks the writer designed the arrangement shown in the accompanying illustration.

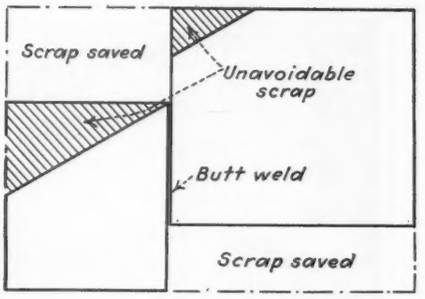
A light cord reel *A* of the proper capacity for the length which the trolley *B* would have to travel was fastened at one end of the assembly line. Lengths of standard rolled C-section channels *C* were purchased, rollers *D* were journaled in the adapter plate *E*, and a piece of electrical conduit piping *F* was bent up as shown and fastened to the plate by means of blocks *G*. Cold-rolled steel suspension straps *H* were then bent up and fastened to channel and ceiling.

Cable *I* was then threaded through the pipe, a spring *J* was fastened on the curved end of the pipe to prevent abrasion of the cable, and the device was ready for use after plugging in connector *K* at a feeder outlet. A pin was inserted at *L* to prevent the trolley from coming off the rail.

Whenever one workman desired to use the portable tool, it was shot down to him by the workman nearest. If desired, a cluster of pipe hooks can be arranged with a central convenience outlet either on the pipe or on the trolley plate. Then any tool of the group can be plugged in with a short length of cable.

Mr. Honneger's contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.





Welding Small Plates Reduces Scrap

F. E. WIKANDER
Plant Layout Engineer
Murray Corporation of America
Detroit

To save scrap in the blanking operation on a rear quarter panel, this company butt welds two smaller sheets rather than blank out a large, single sheet. After a special planer-type machine has trimmed the flash, the composite sheet passes through flattening rolls, emerging ready for blanking.

•

Making and Joining Round Leather Belting

JOHN E. HYLER, *Peoria, Ill.*

On many light drives operating at high speed and on short centers, round leather belting may well be used. Round belting usually is used in diameters of $\frac{1}{4}$, $\frac{5}{16}$, and $\frac{3}{8}$ inch, although other sizes are to be had. It is possible, in an emergency, to make round belting of strips cut from a flat leather belt. This is done by sharpening one end of a pipe nipple by grinding a bevel around the outside, and pulling the strip of leather through the nipple, held in a vise. One end of the strip must be cut down so that it can be passed through the nipple.

A round leather belt can be made endless by gluing it, in much the same way that a flat belt is joined. A wood block about 3 inches long will be needed, with a hole the same diameter as the belt to be joined, bored the long way of the block. The block should be ripped in two so as to leave half of the drilled hole running longitudinally in each piece.

The belt must be scarf-lapped, giving a lap about 1 inch long, by nailing it to a block and using a carpenter's plane.

Grooves in the clamp-block should be lined with paper. After applying belt cement or glue the joint should be carefully placed in one of the

Pays to advertise. Yet many an industrial plant, many an industrial town, fails to tell visitors what it makes. High Point, N. C., is a notable exception to this rule. Lest anyone be uninformed of its principal industry, the local chamber of commerce has erected this giant information "bureau"

block halves, the other half placed over it, and pressure applied with a vise or clamp. The belt should be allowed to stand at least 12 hours, preferably twice that long or longer, before using. After removing from the blocks the joint can be smoothed with emery cloth.

When the use of a glued joint is not advisable it is common practice to use a wire hook type of fastener to hold the ends together. In applying this type of fastener a hole is put through the center of the belt with an awl at a distance from the end equal to the diameter of the belt.

Hook fasteners are received partly open, so that the belt ends are simply hooked into place and the fastener is closed with a hammer or pliers. If the fastener is driven too tightly, the leather will be injured and the joint will fail before it should.

Operators sometimes stretch round belting too tightly, so some manufacturers furnish belt hooks of such strength that they will pull open if the safe tension limit on the belt is exceeded.

•

If, in your factory office, you face the prospect of stifling in summer heat because dirt and soot forbid the opening of windows, air conditioning units may be your solution. That was the discovery of a Pittsburgh concern.

•

Conditions Bad, Maintenance Good

Manufacture of ice and the freezing and cold storage of foodstuffs necessarily result in a large proportion of the motors in an Eastern plant being subjected to excessive amounts of moisture; some of those in the storage rooms are covered with frost, when idle. Nevertheless, during the past seven years it has been necessary to rewind only three or four motors, and at least one or two rewinds were due to bearing failure, rather than deterioration of the windings. Credit for this record belongs to the system of inspection and upkeep.

Every motor is carefully inspected once a month, including measurement of the insulation resistance. Records are kept of these monthly tests, so that comparison of previous insulation resistance values makes it easy to pick out at once any motors that are gradually breaking down. When the insulation resistance of a motor reaches a value of 1 megohm, it is sent to a repair shop for cleaning, baking, and reimpregnation. The expense is only a small percentage of the cost of a rewind. The actual saving, of course, is not only the cost of rewinding, but the maintenance of service, by far the more important.

In the shop the motor is first baked for several hours, washed with gasoline and again baked. This process is repeated until the winding is clean and dry, after which it is immersed in a high-grade, insulating varnish. After impregnation the motor is baked at 235 deg. F., and then given a second dip and bake.

After this treatment the insulation resistance reading is practically infinity.

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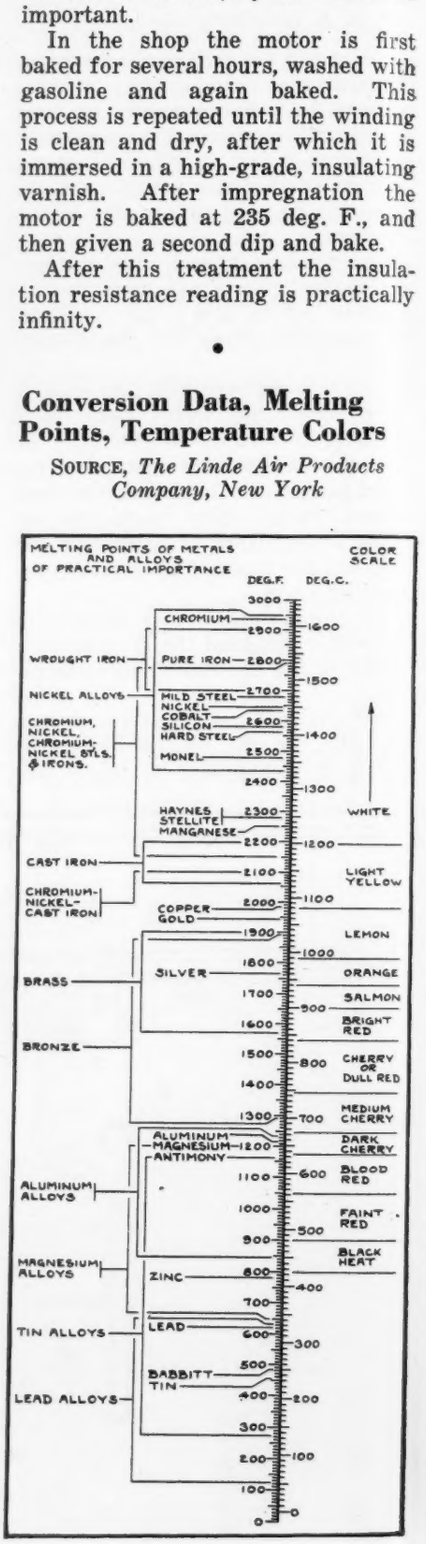
Conversion Data, Melting Points, Temperature Colors

SOURCE, *The Linde Air Products Company, New York*



Air Conditioning Solves Small Plant Office Problem

T. A. BISSELL, *Chicago*

Generally the last consideration in the re-layout of a plant is the location of its office. In the case of the Lanzit Corrugated Box company, Chicago, the space leavings were located on the top floor of a multi-storied building facing the west. In summer, conditions for the office workers were almost intolerable. The sun beat down on the office roof most of the day, and hot prairie breezes from the west added to the heat and discomfort.

To remedy this condition the company recently installed an office air-conditioning system for the comfort of its eight employees and visiting salesmen and callers. The system maintains a year-round temperature of 70 deg. F., dehumidifying and cooling the air in summer, humidifying and heating the air in winter. Relative humidity of 50 per cent is maintained in summer, 40 per cent in winter.

The photograph shows part of the 75x25x12-ft. office space conditioned. Three conditioned-air inlets are shown at the top the rear wall, with outlets at the bottom. The system circulates air at the rate of 5,000 cu.ft. per min., or at the rate of one change every five minutes. Inlet air make-up is 60 per cent re-circulated and 40 per cent outside.

Cooling is accomplished by a 13-ton compressor driven by a 15-hp. motor. A 2-hp. blower circulates the air which is dehumidified by cooling to below the dew point, humidified by a spray. In winter, steam coils heat the air. Dust, noise, and dirt are kept out by keeping windows closed. Thermostatic control is employed.

As expected, results showed a marked improvement in employee efficiency, not only in summer, but during the entire year. Along with the increased comfort there came a better morale.

•

Consumption of twister-ring grease in a textile mill was running so high that a change to a cheaper grade seemed imperative. Investigation showed workers salting the grease and using it for butter. Remedy: a violent cathartic mixed with the grease.

•

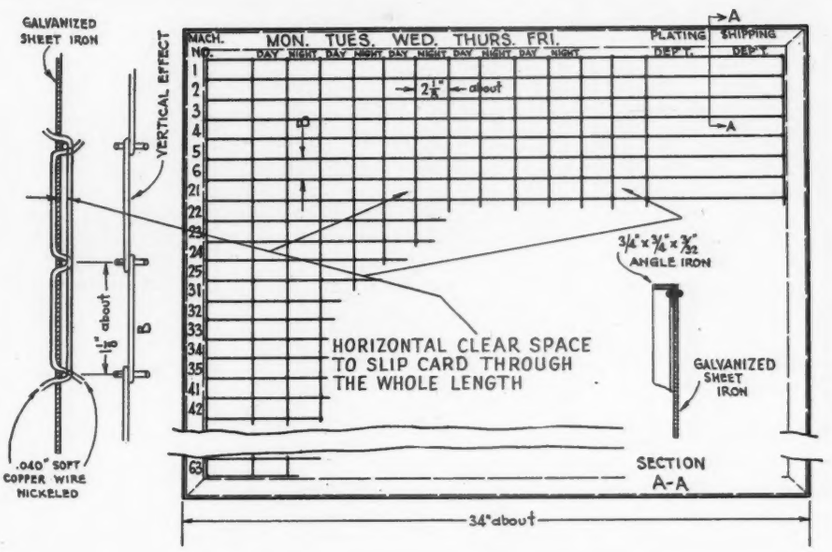
Three-Color Motor Wiring Eliminates Circuit Tracing

SIDNEY MULTZ, *New York*

It has been my practice in wiring motors to use a color scheme which has enabled me to go back to the same job a year later and, without tracing or testing, locate my line, field, or armature.

The system is simple. Keep in mind to "LAF" and be patriotic.

L = line—red
A = armature—white
F = field—blue



Production Control Board for Job Orders

A. E. ZIERICK, *Chief Engineer*
F. R. Zierick Manufacturing Company
New York

When the man in charge of production left our plant, the responsibility of scheduling and following up production fell to me. To keep track of the production of some thirty-odd machines and to schedule them was more than I could manage without the aid of a control board, as I had other duties which occupied a great part of my time.

The control board (above) I constructed to help me is simple. In making it all horizontal wires were pulled straight across the front face of the board and through the holes at the ends of their designated lines. The vertical wires were laced over the horizontal wires and through the holes in the sheet iron as shown in the enlarged fragmentary view. All the wires were pulled taut with pliers. Short lengths of wire were used, and twisted joints were made at the back of the board.

Before lacing the wires, a coat of gray paint was given the front face to contrast with the nickeled wire. The spacing of the holes was held uniform by the use of a bar jig.

Recording is made on strips of paper, slipped horizontally behind the vertical wires, by pencil entries under their proper predetermined headings. Quantities are recorded in black and repairs in red. New set-ups are shown in blue. Keeping tabs on repairs is important, especially when employing six or more toolmakers.

Order tickets are placed on each producing machine. The weight of

material designated agrees with the amount of finished pieces required. When the material is all consumed the order is completed. This arrangement works out satisfactorily only when the machines are run without interruption. To avoid either overproducing or running short of the required quantities, new order tickets are issued whenever a job on a machine is delayed for a day or more.

Another convenience of the board is that samples can be hung along with the order numbers. The speed of each machine is given in the extreme left vertical column with the machine numbers. In this way, the approximate time can be computed for any job. Stop notices then check with the material consumed. The schedule for new jobs can thereby be predetermined. Jobs have their order tickets stamped by a time clock when they are finished in one department and ready for the next.

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Roofless Wall Kills Substation Noise

H. S. KNOWLTON, *Boston*

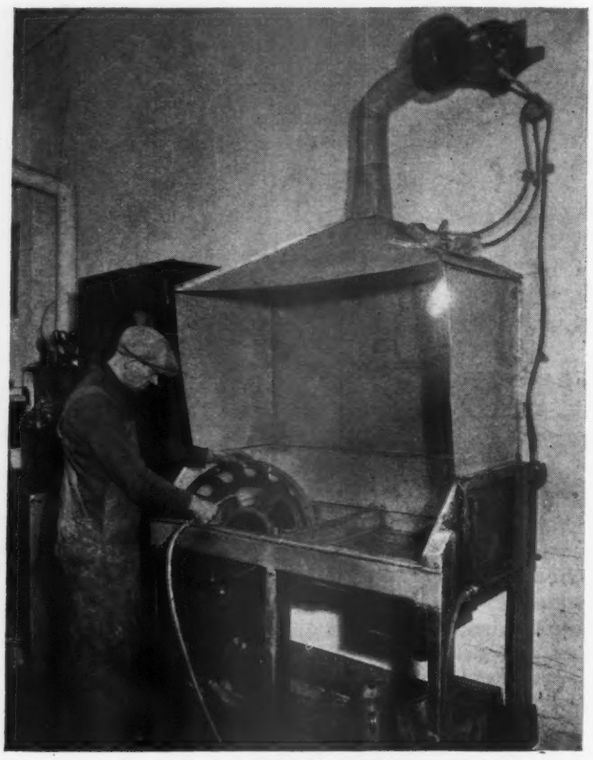
In a Massachusetts power substation complaints of transformer noise were received from adjacent houses in the rear and at a higher elevation. Investigation showed that noise either traveled through the air or was conveyed through the ground as vibrations. Ground-conveyed vibrations could probably be cured by mounting the transformers on special foundations isolated from the surrounding structures.

In the case in point it was found that the noise was not constant but depended on the direction of the wind. Since this indicated that the objectionable noise was transmitted through the air, a 4-wall brick inclosing structure was built about the transformers and carried up above the buses. No roof structure was provided. The noise is now shot upward and passes over the houses.

Cleaning Motors

SOURCE, *General Electrical Specialty Company, Jamaica, N. Y.*

Cleaning of motor frames and other parts was formerly done at this plant in buckets and tanks on



the floor. This galvanized iron cleaning bench and hood greatly facilitate the work. The two compartments permit cleaning with dirty gasoline at the left, and rinsing with clean gasoline at the right. Carbon-tetrachloride is also sometimes used in one compartment. The lighting fixture shown is explosion-proof and, connected in series with the motor at the blower, serves also as a pilot light to insure that the blower is operating when an explosive cleaning fluid is employed.

•

More Light, Fewer Rejects

When Crowe Name Plate & Manufacturing Co., Chicago, noticed many more rejects chargeable to the night shift than to the day in its buffing division, it decided that the illumination in that department must be to blame.

A survey showed an average of only 5 foot-candles at the working plane, with confusing high lights and shadows.

New lighting was installed. Now 200-watt lamps in glass-steel reflectors, on 8-ft. centers, give an average of 40 foot-candles at the work.

Results were soon apparent: rejects on the night shift have been reduced to the same small average as those on the day side.

SPECIAL NOTICE

$10 will be paid for the best Operating Short submitted during the month of July. The Editors are the judges. Other Shorts accepted will be paid for at attractive space rates

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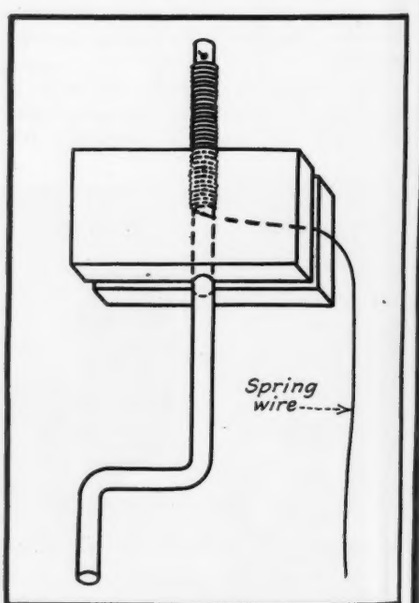
Simple Winder for Coil Springs

L. S. WEIMER, *Beaver Dam, Wis.*

To make a small coil spring, take a steel rod whose diameter is slightly less than that of the spring and bend this rod in the shape of a crank. Drill a small hole through the end of the rod, thread the spring wire through this hole, and clamp crank and wire between two wood blocks in a vise. The drill hole in the rod should be about halfway through the block at the start. Now use the crank end to turn the rod. This will drive the rod through the block and wind the wire tightly and uniformly. An old violin string may be used for small-sized springs and any spring wire for larger sizes.



Laying Out Individual Drives

Mounting motors high enough to avoid falling material and planning drives with good factor of safety are effective ways to avoid trouble

ROBERT W. DRAKE
Mechanical and Electrical Engineer
Indianapolis

WHEN a new installation, or a major rearrangement, of machines is to be made in the average industrial plant much thought is invariably given to the selection of the machines. Usually some study is given to machine arrangement, although this matter is sometimes neglected. Very frequently in the press of other work the engineering department turns over to the millwright foreman a sketch showing machine locations and leaves the details of drive application and mechanical power transmission to him. This procedure may leave the matter in very capable hands.

It has been the universal experience in large plants where comparative records have been kept, that the number of motor failures per hundred installed is much less on those drives where the motors are mounted high as compared with drives with motors mounted low.

A large proportion of the failures of low-mounted, open motors results from the entrance of foreign matter. Waste material from nearby machines falls down, not up. Thus a motor that is mounted high escapes in large measure this cause of failure. The same situation holds with dripping oil, cutting compound, coolant used in the driven machine or adjacent machines, and drip from material in process.

The Higher, the Better

I prefer in general to bracket the driving motor as high up as the construction of the driven machine will allow, even at considerable increase in expense. It is best to keep the motor and bracket high enough to clear a man's head even when the motor is bracketed behind the machine, as for example, on a press. Mounting in this way saves much floor space and gives wrench room when overhauling or adjusting the machine.

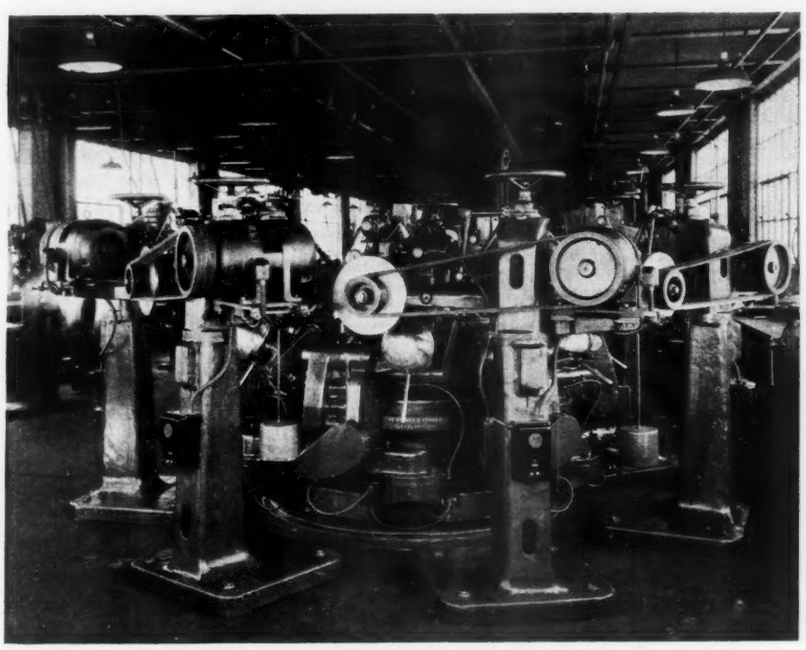
On how many machines in your shop is it necessary first to remove the motor before making even minor adjustments, to say nothing of heavier repairs? Did you ever stop to estimate what the additional repair time cost? Or a much more serious matter, what the consequent increased delays cost? Are your men saints or angels? Or are they mere humans, like mine, who neglect even minor adjustments if they must remove and realign a motor in order to make them?

When it is absolutely necessary to mount a motor low, it is well worth while to use a totally inclosed type if the motor required is not over 2-horsepower rating, or an inclosed, fan-cooled motor if a larger size is required. The first cost of such motors is greater, to be sure, but troubles from the entrance of foreign matter are eliminated. Hence, the annual cost, including fixed charges, maintenance and repairs, and the cost due to manufacturing delays, will be much less.

For Direct Drives, Inclosed Motors

In most instances direct connection, direct gear drive, direct drive through a speed reducer, or use of a gearmotor preclude the possibility of an overhead mounting for the motor. For such drives a totally inclosed or an inclosed, fan-cooled motor is indicated. It is, however, becoming more and more usual to interpose a flat or V-belt or a chain between such reducers and the driven machine. This arrangement is particularly desirable when the speed reduction required between the motor and the driven machine is large.

There are several advantages to such an arrangement. For one thing, the use of flat or V-belts damps out vibrations and eliminates



There's not much chance of falling water or objects causing motor trouble and shutting down this polishing machine. Motors are inclosed, fan-cooled

shock to the motor and machine breakage when something jams.

The greatest advantage of all lies in the fact that the interposition of a band drive of some sort makes easy any changes in machine speed that may prove to be desirable after the machine is in production. The difficulty of changing machine speed when a speed reducer or gearmotor is applied directly, often prevents worth-while reductions in manufacturing cost that could be made by altering machine speeds to meet new conditions.

The advantages of using belts between motors and individually driven machines have been recognized for years. The one disadvantage—the difficulty of eliminating slip on short-center belt drives, particularly when these are vertical—has been overcome in several ways in recent years as explained in detail in previous articles. Obviously, these more recent developments in short-center drive design should be used in planning high-mounted motor drives.

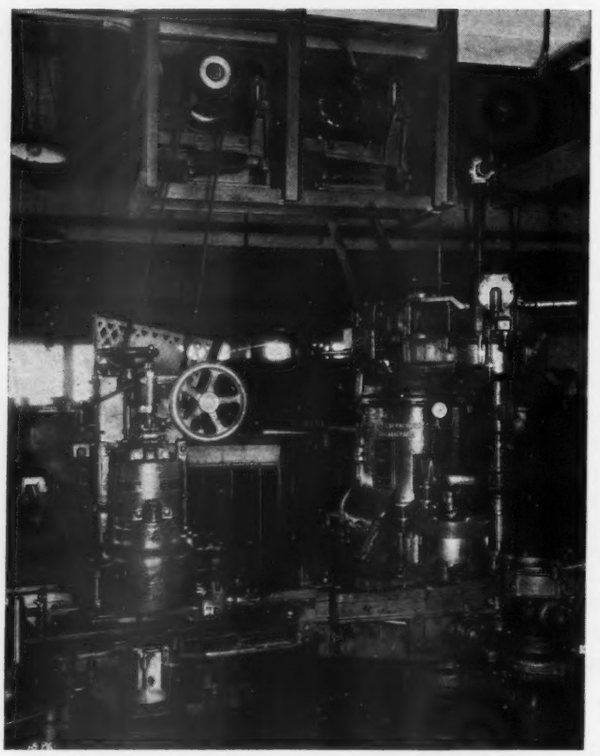
Liberal Design Important

In this connection a few brief suggestions on proportioning the short flat belt, V-belt, or chain drive from motor or reducer to machine drive shaft may be of value.

First, plan the mechanical transmission devices between motor and driven machine liberally. Don't forget that while starting a standard induction motor exerts a gradually increasing torque that ranges from 1¼ to 2 or more times full-load value just as the motor starts, up to 2½ to 3½ times full-load torque when the motor reaches about two-thirds to three-quarters full speed. In fact, with some lines of single-phase or three-phase motors operated somewhat above rated voltage the maximum torque reaches 4 to 5 times its full-load value. The very high, short-time and momentary load fluctuations characteristic of individual drives as a class are limited only by the above-mentioned stalling loads of 2½ to 4 or 5 times rated motor capacity.

In the exigencies of competitive purchasing, where price may be a controlling factor in a decision, this fact is often lost sight of. The tendency is to install drives that are planned only for the rated capacity of the motor, without any allowance for load peaks. This tendency is the principal cause of trouble and short life of drives.

Consider the surroundings in proportioning a drive. Overbelt in dry, moist, or dusty locations, particularly if the dust is greasy, as, for example, in a cotton oil mill. Be sure to inclose gears or chain in the presence of abrasive dust. Avoid the use of oak leather belting "up behind the furnaces" where temperatures exceed 125 deg. F.; avoid special-tannage leather where temperatures in excess of 150 deg. F. are encountered.



It cost more, no doubt, to mount these motors high up where things cannot fall into them, but it is good insurance against motor trouble and production delays

High Speeds Shorten Life

Do not use extreme belt speeds, extreme pitch line speeds for gearing, or extreme chain speeds. The life of the drive will be reduced, and manufacturing delays and maintenance cost will be increased with such drives. Occasional applications require that all materials be pushed to the extreme limit, in order that the driven device may function. However, it is never economical to go to 6,000 f.p.m. flat belt speed, or 2,000 f.p.m. chain speed, or 4,000 f.p.m. V-belt speed merely to save the additional first cost of a slower-speed motor or to get a cheaper drive.

Fit Pulley Diameter to Horsepower

Avoid the use of pulleys, sheaves, sprockets, or pinions that are too small in diameter for the horsepower to be transmitted. With pulleys or V-belt sheaves it is seldom advisable to go below the manufacturer's standard pulley diameter for the motor in question, and never advisable to go below the manufacturer's recommended minimum diameter, because of probable bearing trouble. The same principles hold true with pinions; 14-tooth pinions give an operable drive, but their use is not advisable if pinions with 16 or 18 teeth can be used.

On silent chain drives it is inadvisable to go below 19 teeth if the chain is really hard driven for its size. The motor sprocket on a chain should not be smaller than one-half the manufacturer's standard pulley diameter, and not that small if it can be avoided.

Probably a small, fine-tooth pinion can be designed for any horsepower whatever by making it wide enough; practically, it is not possible to obtain and maintain alignment.

As a practical matter there is little or nothing to be gained in life or capacity by making a motor pinion wider than three times the distance from center to center of the teeth on the pitch line.

In the case of a sprocket for silent chain, the designer may use considerably greater face widths without deceiving himself, because if exceptional care is used in aligning the drive, the slight give in the chain and pins and in the many oil films at the pins will help to equalize the tooth load across the sprocket face.

When You Select Cable

Installation and service characteristics play an important part in determining the kind of insulation and finish that will be required

H. M. FRENCH
Industrial Engineering Department
General Electric Company, Schenectady, N. Y.

EVERY industrial plant uses some insulated cable. Upon it depends to a large extent the successful operation of the plant. Despite this fact plant men often give too little thought to the selection of cable. Too often it is bought strictly on a price basis. Price rightly enters into the decision, but initial cost should not be allowed to overshadow other factors that are often of comparable or greater importance.

Insulated cable, or wire, has only three fundamental parts; conductor, insulation, and finish. The first is selected according to the load (current) to be carried; the second according to the voltage of the circuit, and temperature and moisture conditions; the third according to the installation and operating conditions. Therefore, cable selection for a given installation involves choice of each of these three items according to the following factors:

1. Power use
2. Size of units served
3. Power factor (of plant or of circuit)
4. Prevailing voltage
5. Hazards
6. Cost and service considerations
7. Time cable is to be used
8. Location of runs
9. Distribution of units served
10. Installation facilities.

The first three factors have to do with the size (cross-section) of the conductor, the fourth with the insulation, and the fifth with the finish or protection. The remainder are general considerations, primarily affecting cost.

Use Affects Cost

In some instances an outstanding hazard such as heat or some feature of the installation will completely overshadow all other conditions and indicate clearly the type required. At other times several types may be technically satisfactory; then the choice will be an economic one, and frequently includes more than first cost.

Naturally, many special problems arise in actual practice which should be put up to the cable manufacturer.

The amounts and kinds of cable involved will depend on whether the power is to be delivered principally to large motors, small motors, furnaces, electrolytic processes, and so on.

Cable cost per horsepower or per kilowatt will be highest when power is delivered to a large number of small motors. These are likely to be widely scattered; even if concentrated they will usually be at some distance from the substation, which necessitates long cable runs and larger sizes to offset the higher voltage drop. To improve this situation a practice widely followed in cement mills is to use departmental substations. Power is brought from the main switchboard at 4,400 or 2,300 volts and stepped down for the motors. Long runs are thus made at high voltage and low current, which reduces the size and cost of the cables.

Demand and Power Factor

Cable runs for lights must, necessarily, be widely spread. Here, too, both cost and voltage drop will be saved by the liberal use of lighting transformers connected in the main power circuits at frequent intervals.

The kilowatt or kilovolt-ampere demand of the principal units served largely governs cable size (diameter), from the standpoint of either heating or voltage regulation. For underground cable the load factor is also important.

Cables in air are usually rated on the basis of the maximum load which they will have to carry.

Price per thousand feet does not go up in proportion to the carrying capacity. With one common type of cable, multiplying the capacity by six multiples the price by less than two and one-half.

Power factor has a pronounced effect on cable size. Reactive kilovolt-amperes, either lagging or leading, increase the amount of current carried per kilowatt and hence the size of the cable. For example, a circuit load of 600 amp. at unity power factor becomes 800 amp. at 75 per cent power factor.

Voltage and Insulation

The voltage at which the cable is to operate determines the type of insulation, its thickness, and the minimum size. In general, industrial requirements fall between 220 and 4,400 volts, with many applications under 600 volts. A voltage of 2,300 is common, particularly where power is brought directly to the motor from the main substation.

For the usual applications the accompanying table will serve as a rough guide in selecting the type of insulation for various voltages.

Proper cable insulation should have the following characteristics:

High dielectric strength
Long life
Resistance to high temperature
Mechanical flexibility
Resistance to moisture
Low dielectric loss.

Insulation of high dielectric strength is much lighter for a given voltage than low dielectric strength insulation. Use of the former thus saves on size, weight, and cost.

The higher the temperature which the insulation will withstand, the greater is the load the cable can carry. Therefore, for heavy loads and high temperatures use insulation with good heat-resisting properties.

During installation cables are frequently bent and twisted consider-

ably. In service they are subjected to some bending. In some applications the cable must be reeled and unreeled frequently, as on mine locomotives. Hence, cable should have a certain degree of flexibility.

Besides the finish used, insulation should be moisture-resisting. In general, rubber insulation is regarded as moistureproof. Varnished cambric may or may not require a moistureproof finish; paper always does.

Insulation of low dielectric loss saves power and increases current-carrying capacity. These conditions make the use of low-loss insulation imperative at high voltages and desirable at others.

Selection of the proper finish depends on installation conditions: in other words, on the hazards. In many industrial plants as a whole, or in certain departments, water, steam, dust, acid, fumes, oil, and so on are present. In others the ambient temperature is high.

Trailing cable, used on power shovels, electric locomotives, and portable tools, is subject to severe mechanical hazards such as being dragged over sharp rocks, run over by trucks and locomotives, or gouged by sharp blows.

Finishes may be classified as metallic and non-metallic. Metallic finishes include:

Pure lead sheath
Reinforced lead sheath
Alloy lead sheath
Flat-band armor
Interlocked armor
Wire armor
Basket-weave armor.

With the possible exception of lead sheath such finishes are strong mechanically, highly resistant to wear and abrasion, flame-resisting, but not moistureproof. Excepting the wire armor, they have low tensile strength.

These finishes are or can be made highly resistant to weathering. They are, however, liable to corrosion when installed underground and under such conditions require special treatment.

Lead sheaths are moistureproof and highly resistant to most forms of corrosion. Where both mechanical strength and moistureproof qualities are required, a combination of lead sheath and armor should be used.

The more common non-metallic finishes are:

Weatherproof braid
Seine-twine braid
Loom-woven sheath
Flame-resisting braids
Rubber-hose jacket
Tellurium-compound jacket
Glyptal compound sheath
Impregnated-jute finish
Jute and asphalt
Abrasion-resisting finishes
Non-metallic, corona-resisting tape
Treated-duck tape.

These finishes are not subject to corrosion, although some may rot off in time under severe weather conditions. All of the rubber finishes are waterproof.

Cable that is hardly good enough for one job may be too good for another, depending upon the expected life of the plant, effect of loss of power on products and equipment, and the cost of cable as compared to total cost.

A sand and gravel pit opened for a neighboring road contract would

(Continued on advertising page 56)

Recommended Voltage Limits for Insulation

Class	Shielding	Finish	Conductor	Maximum Voltage	Minimum Voltage
Paper					
Oil-filled	Non-shielded	Leaded	Single	230,000	60,000
Oil-filled	Shielded	Leaded	Multiple	75,000	35,000
Standard solid	Shielded	Leaded	Single	69,000	40,000
Standard solid	Non-shielded	Leaded	Single	40,000	
Standard solid	Shielded	Leaded	Multiple	35,000	10,000
Standard solid	Belted	Leaded	Multiple	10,000	
Varnished Cambric					
Standard varnished-cambric insulation	Non-shielded	Leaded	Single	26,000	
	Non-shielded	†Braided	Single	7,500	
	Shielded	†Braided	Single	26,000	7,500
	Shielded	Leaded	Multiple	26,000	10,000
	Shielded	†Braided	Multiple	26,000	7,500
	Belted	Leaded	Multiple	10,000	
	Belted	†Braided	Multiple	7,500	
Asbestos					
Asbestos-varnished-cambric	Non-shielded	Leaded	Single	13,800	
	Non-shielded	†Braided	Single	13,800	
	Non-shielded	Leaded	Multiple	13,800	
	Non-shielded	†Braided	Multiple	13,800	
Felted-asbestos	Non-shielded	†Braided	Single	600	
Rubber					
*Special compounds	Non-shielded	Leaded	Single	15,000	
30 per cent A.S.T.M. Class AO compound	Non-shielded	†Braided	Single	6,000Y 3,500△	
	Shielded	†Braided	Single	15,000	6,000Y 3,500△
	Shielded	Leaded	Multiple	15,000	10,000Y 6,000△
	Shielded	†Braided	Multiple	15,000	6,000Y 3,500△
	Non-shielded	Leaded	Multiple	10,000Y 6,000△	
	Non-shielded	†Braided	Multiple	6,000Y 3,500△	
20 or 25 per cent N.E. code compound	Non-shielded	Leaded	Single	5,000	
	Non-shielded	†Braided	Single	3,000	
	Non-shielded	Leaded	Multiple	3,000	
	Non-shielded	†Braided	Multiple	3,000	

*Special compounds rated same as 30 per cent A.S.T.M. Class AO.
†Not mounted on insulators.

For Motors, This Maintenance

If you would increase reliabilty of service, give the proper care to commutators, sliprings, brushes, to bearings and all mechanical details

C. L. KEENE
Supervising Engineer
The Ocean Accident & Guarantee Corporation, Ltd.
New York

SUCCESSFUL operation of d.c. machines is contingent, to a great extent, upon the care given to the commutators. The commutator should have a smooth, clean, glossy surface. If the mica is undercut the slots should be kept free from carbon and copper dust; otherwise, the armature coils will be short-circuited and probably overheat and burn out. Rough, deeply grooved, or eccentric commutators should be trued up by grinding or turning.

Commutator and armature failures are frequently due to deterioration of the mica between commutator bars, or between the commutator and the machine shaft or spider, caused by oil. For this reason it is important to examine carefully to determine whether there is any possibility of oil reaching the mica. It is good practice to wipe the bearing reservoirs and the shaft frequently with clean rags, to remove any oil that may have accumulated. Gasoline, kerosene, or carbon tetrachloride, preferably the latter, may be used to wipe the commutator surface.

It should be remembered, however, that if gasoline, kerosene, or other highly flammable solvent is used, it should not be applied to the surface while hot and the commutator should be thoroughly dried before the machine is again placed in operation.

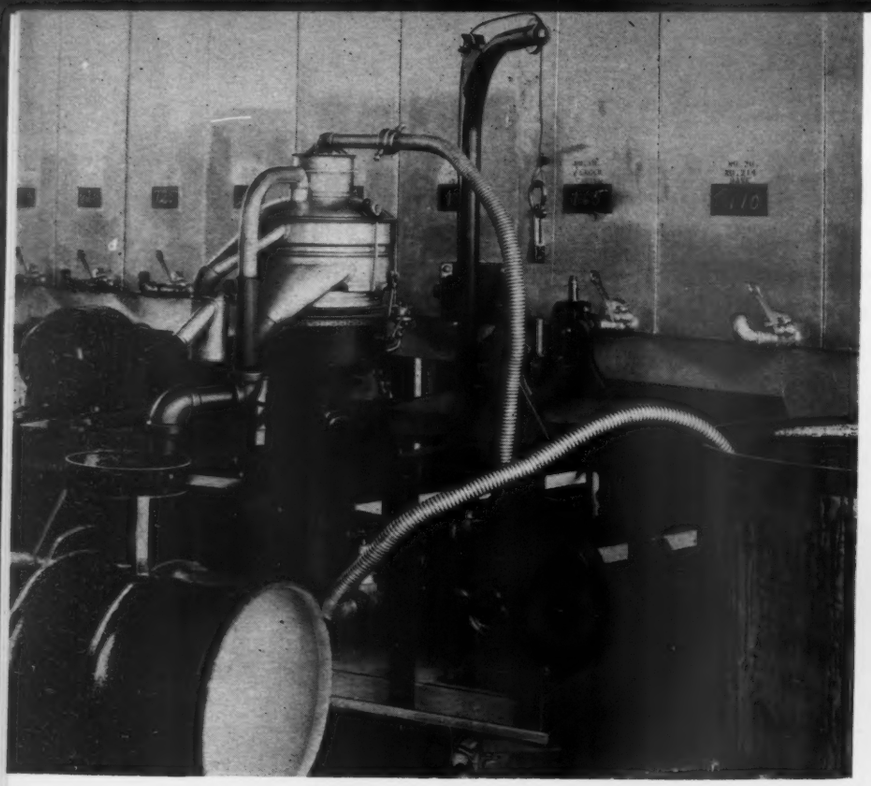
Signs of Trouble

If the commutator mica is dark in appearance, honeycombed, and soft, it is a sure sign of oil. When the side mica is oil soaked arcing takes place between bars, accompanied by ring fire at the brushes. If the trouble is noticed in its early stages it is possible to make a satisfactory, temporary repair by removing all carbonized mica and filling the slots with a commutator compound marketed by manufacturers of electrical equipment. Such a repair may hold up for a comparatively long time, but in the end it is usually necessary to rebuild the commutator and put in new mica.

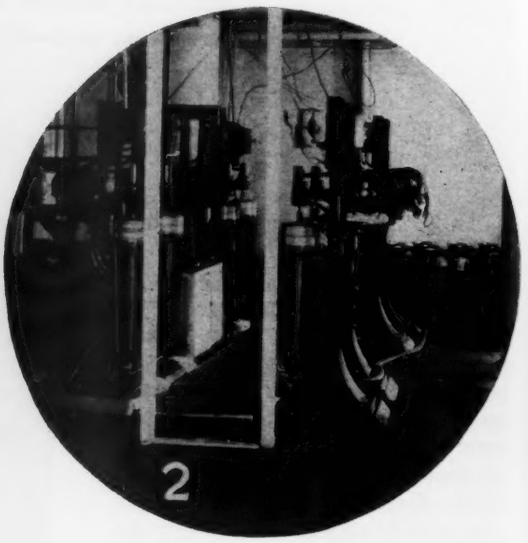
One sure indication of trouble on a d.c. machine is sparking at the brushes. Unless the sparking is eliminated it will cause additional trouble and expensive repairs. Some of the causes of sparking of the brushes are: overload; vibration; binding or sticking of the brushes; rough or eccentric commutator; open-circuited armature; high or low bars; dirty commutator surface; grounds; weak field; poor brush contact; improper brushes. The remedies to be applied for these troubles are obvious.

Care should be exercised in selecting brushes. The manufacturer of the machine or a reputable brush concern should be consulted. Attention should also be given to brush position and tension. Incorrect brush angle may cause binding or chattering of the brushes or breaking of the brush tips, in addition to sparking. For ordinary, medium-speed machines running under normal operating conditions, and with rotation against the sharp edge of the brush, experience shows that 37½ degrees is the best angle to use. For rotation against the dull edge a brush angle of 15 to 20 degrees usually gives good results.

(Continued on advertising page 53)

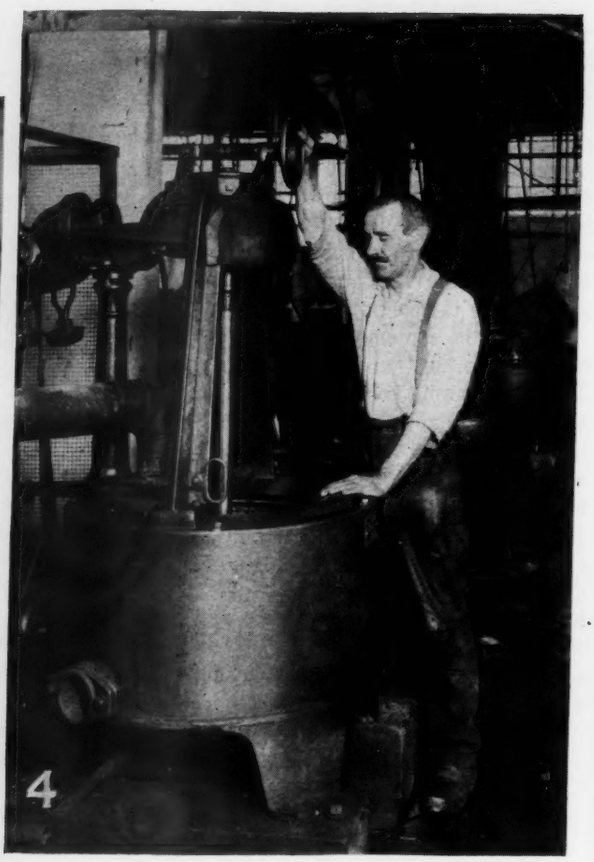


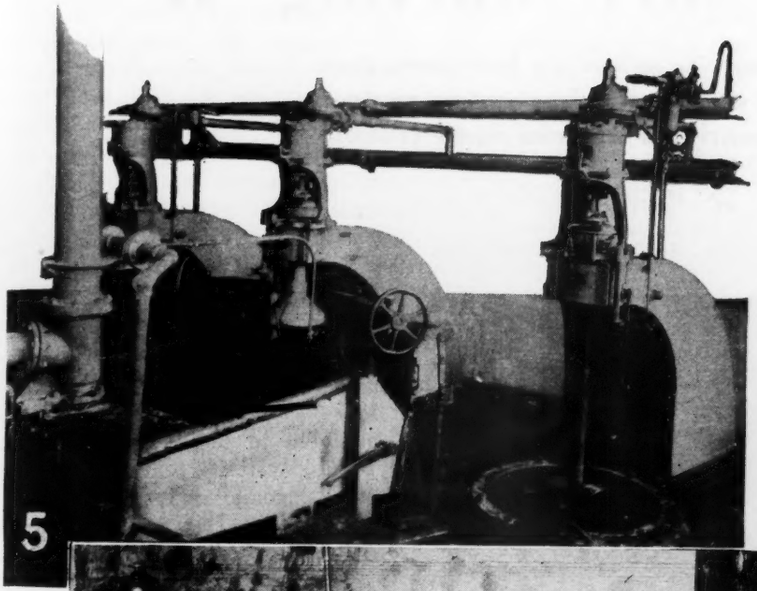
(1) Treating materials and products in a paint and varnish plant . . . (2) collecting acidophilus bacillus . . . (3) reclaiming railroad car journal packing . . . (4) drying plated parts

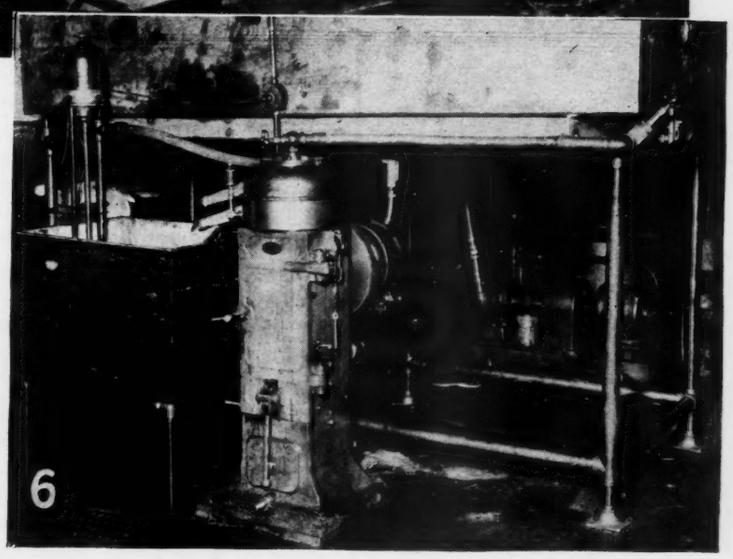


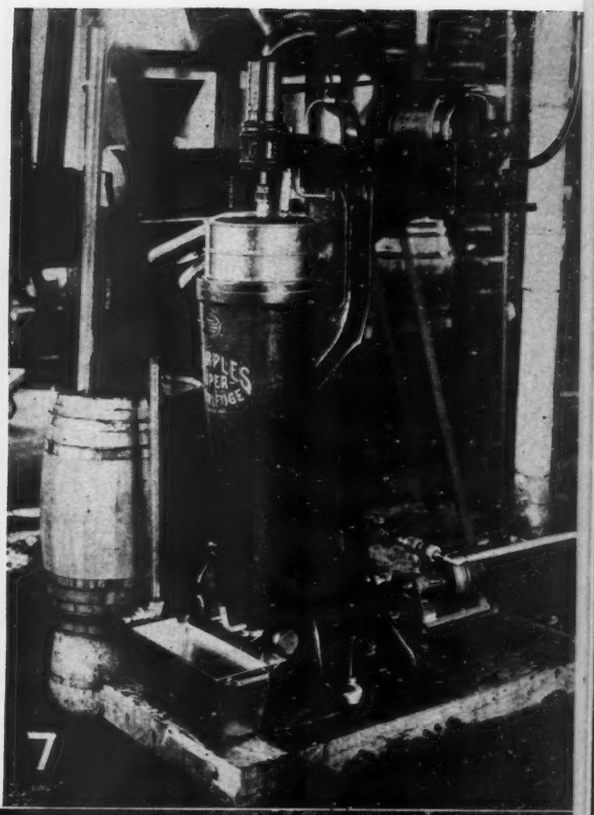
Centrifugals at Work

Doing a few of the jobs for which industry finds them indispensable









(5) Drying ammonium sulphate crystals in a coke byproducts plant . . . (6) reclaiming cutting oil in a metal-working plant . . . (7) clarifying apple pectin and fruit juices . . . (8) removing foreign matter from paper stock

For Safe, Sure Starting—II

It is necessary to select an inclosure that will protect the starter mechanism against any gas or material that can cause trouble

N. D. BUEHLING
Industrial Engineer
Allen-Bradley Company, Milwaukee

LAST month some general principles governing the selection of suitable starter inclosures were discussed, with special reference to starters used in hazardous locations.

Class II locations are those in which (1) combustible dust is thrown, or is likely to be thrown, into suspension in the air in sufficient quantities to produce explosive mixtures or, (2), those where it is impracticable to prevent such combustible dust from collecting in such quantities in or on electrical equipment that overheating is likely to develop because normal radiation is prevented. Only the first factor is considered in starter selection, since this equipment never heats appreciably. The more common dusts that form explosive mixtures include grain, starch, wood, coal, cork and certain dusts of aluminum, tin and so on.

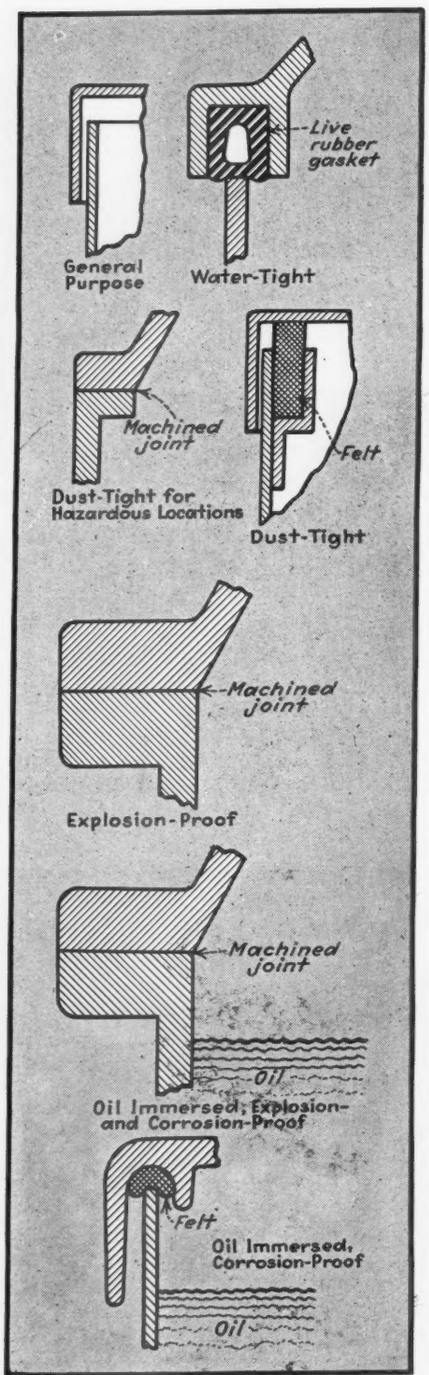
Obviously, Class II hazardous locations are encountered in grain and coal elevators, sugar refineries, and the like. Here it is possible to keep out the dust, which is sufficient to prevent an explosion. Inclosures for such locations must, therefore, be dust-tight.

When Danger Is Less

The explosion-proof starter described in the preceding article is truly dust-tight, and could be used for hazardous dust locations. However, its construction is expensive, and a lower-priced inclosure that will serve equally well for Class II locations is commonly used. Similar in construction to the explosion-proof inclosure, the body metal is thinner since it will not have to withstand internal explosions. Like the explosion-proof inclosure, it has a machined metal fit between the cover and the box to exclude dust, but the flange is narrower.

Class III locations are those in which easily ignitible fibres or materials producing combustible flyings are handled, manufactured or used. Fibres such as cotton, excelsior, and jute are termed easily ignitible. Hence Class III locations are encountered in cotton gins and compresses, cotton mills, upholstery establishments, mattress factories.

In Class IV locations easily ignitible, combustible fibres are stored and handled. The materials involved are similar to those in Class III, but only the storage of combustible fibres is considered; so this classification applies mainly to warehouses.



Types of joints used between cover and base of starter inclosures for different operating conditions

Dust-tightness May Be Enough

For Class III and IV locations, no special standards have been drawn up, and requirements are the same as for Class II locations. The dust-tight inclosure described has proved satisfactory under these conditions. Instead of locating the motor control where hazardous or corrosive conditions are encountered it may be desirable to run the control connections to a separate room having a normal atmosphere. The starters or pilot control devices can then be provided with standard, general-purpose inclosures.

It is necessary, of course, to seal the conduit connections between the two rooms to prevent flammable or corrosive gases reaching the control equipment.

In non-hazardous locations, where an arc or flame would not endanger life or property, the choice of starter is governed entirely by the cost involved. The cheapest inclosure that will operate satisfactorily over a period of time is the one to choose.

Under normal conditions the so-called general-purpose inclosure will give ample protection. This, the lowest-priced inclosure available, is constructed of sheet metal of the necessary gage.

The term dust-proof has often

been used when referring to starters provided with a general-purpose inclosure, thereby misleading many plant engineers. As pointed out, dust-proof does not necessarily mean dust-tight (capable of keeping out dust); it means only that the apparatus will operate in the presence of dust. Whether a starter is dust-proof depends on the starter mechanism as well as the inclosure. To call an inclosure dust-proof is meaningless. Any starter with a dust-proof mechanism could be termed dust-proof, even if it had no inclosure.

In Corrosive Atmospheres

The dust-tight starter for hazardous dust locations can also be used where non-combustible dust is present. Usually if the dust conditions are not hazardous a lower-priced type of dust-tight inclosure will do. This inclosure is nothing more than the general-purpose, sheet-metal starter with a felt gasket between the metal sheets to prevent entrance of dust. Thumbscrews provide the compression needed to insure a dust-tight joint.

This installation is not permitted by the Underwriters under hazardous conditions.

This dust-tight inclosure is the one that many plant men think they are getting when they order a dust-proof starter. It is widely used in plants where non-combustible dust is found. By keeping out grit, dirt, and metal dust the inclosure protects the starter mechanism.

Moisture inside a starter may seriously interfere with operation. Rusting and corrosion, warped insulation, and electrical leakage result from moisture in a starter. A film of rust on the surface of a clapper or solenoid armature may increase the air gap so that an excessive current is required, and the coil may burn out. With serious rusting the armature may lock or "freeze" the starter in an open or closed position. Salt water or water containing any one of a number of chemicals is highly corrosive and will ruin the starter mechanism.

When atmospheric conditions are normal the general-purpose inclosure gives satisfactory protection

Across-the-line starter with dust-tight inclosure for locations in which hazardous dust is present

Obviously in paper mills, packing houses, and all plants in which considerable water is encountered starters should have water-tight inclosures. Outdoor installations exposed to the weather must be similarly protected.

So-called "water-tight" apparatus is so constructed that a stream of water from a hose not less than 1 inch in diameter, under a head of about 35 feet and from a distance of about 10 feet, can be played on the apparatus for several minutes without leakage. The standard, water-tight starter inclosure meeting these specifications is constructed of cast iron or steel plate, with a live rubber gasket between the cover and the base.

This type of inclosure will satisfy all requirements for splash-proof, water-proof, weather-proof, drip-proof, and drip-tight installations. It can also be used where dust is encountered, although it is more expensive than the conventional dust-tight inclosure.

The water-tight inclosure will keep moisture out, but it is not air-tight, and cannot exclude gases. Attempts to use water-tight accessories in atmospheres containing flammable gases have sometimes resulted in disaster. A slight gas leak in the cover of the inclosure may cause an explosion inside the starter when the switch contacts are opened.

If a starter operates in the presence of corrosive fumes, particularly if the atmosphere is also humid, the mechanism may corrode badly. If the corrosive action is not severe a water-tight inclosure may give sufficient protection. However, in most chemical plants and places where corrosion is severe, oil-immersed switches are necessary.

Oil immersion protects the starter mechanism by preventing all contact with corrosive fumes. A standard-type switch oil is used, which should be free of moisture and not carbonize readily. When operation is frequent, oil-immersed equipment should be avoided. The average life of contacts under oil is only about 1/30 as long as in air.

Furthermore, switches under oil will weld more easily under high currents than switches operated in air, particularly if the oil is badly carbonized.

Two types of oil-immersed starters are in common use. The first consists of a welded, sheet-metal tank containing the oil and fitted with a cast-iron cover and felt gasket. This inclosure is used where only corrosion is encountered.

Protection for Control Stations

When the atmosphere is both explosive and corrosive, an inclosure, similar to the explosion-proof type is used. It has a heavy, cast-iron case with machined flanges. The starter mechanism is immersed in oil.

Control stations—of which the pushbutton is the most common type—are also exposed to water, dust, explosive and corrosive gases. Protection is more difficult because the switch contacts must be operated from the outside. To impart motion from the outside to the inside of the inclosure requires a bearing surface impervious to dirt, dust, or flame.

(Continued on advertising page 58)

We Save Power Dollars

Ten thousand a year in direct costs, some more in indirect. The cost of our products will be lower, net profit that much higher

H. O. MAY
Plant Engineer
Crocker-Wheeler Electric Manufacturing Company
Ampere, N. J.

DURING the past two or three years almost every plant in the country has had to save every dollar possible. Many concerns in searching for opportunities to cut operating costs have found a fertile field for savings in their power plants.

Our own plant, for instance, consisted of three 400-b.h.p. water-tube boilers generating steam for process work, for heating, and for driving steam engines that in turn drove generators supplying part of our electric current requirements. The furnaces were hand-fired and burned rice coal.

Two conveyors brought the coal from the 1,000-ton storage bin to the power house. Three men were continually employed passing coal and handling ashes. Two men fired the three boilers. During severe weather we often had to put on extra labor. The power house was filled with dust and ashes, could not be kept clean. Coal was poor and unreliable in quality, high in price. Maintenance costs on the coal conveyors were terrific. We were continually having trouble with broken grate bars which left unburned coal in the ashes.

Changed from Coal to Oil

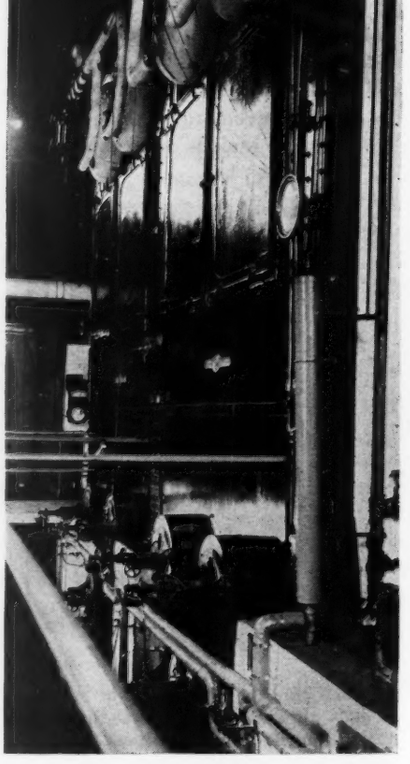
So we considered changing from coal to oil and began to estimate the cost and possible savings, if any. Our three boilers were not new, one dating back to 1907, the other two to 1917 and 1918, but they were in good shape and did not need replacing. Slight changes in the fire boxes were indicated and we discovered that a change in our baffles would increase efficiency. Everything considered, the oil-burner installation, including a 20,000-gallon underground oil-storage tank, section pumps, preheaters, burners, and fire-box alterations would cost us about $13,000.

Among the savings we could expect were: Labor of 6 men; maintenance of conveyors ($200 a year); grate bar maintenance; repairs of firing equipment; demurrage on coal cars; loss of coal through grate bars (estimated at 12 per cent). The cost of fuel we found would practically cancel, with a small margin of saving on the oil. In all we computed the probable saving at $10,000 a year.

Used a Bit of Psychology

Other factors which we appreciated were the reduction of indirect or non-productive labor, and the psychological effect of a clean bright power house as against one that was anything but that.

The change from coal to oil was decided upon. Taking one furnace at a time, we began in July, 1934, and finished in December. Three burners with high and low flame con-



This is a story of getting more for the power dollar. It happens that this plant changed from coal to oil. That, however, is not the point. The conditions might have been reversed. Or the story might have been a change from making to buying power or vice versa. The point we emphasize is that something was done to reduce the unnecessarily high cost of power. It is only the very unusual plant that doesn't have a similar opportunity

trol were installed on each furnace. The tank was put in and around it were run steam lines with thermostatic control to keep the oil at 90 deg. F. Two suction pumps, a reciprocating steam for regular service, and an electric gear pump for auxiliary were set up in what had been the ash pit. And two preheaters were added to bring the oil up to the required 175 degrees for atomization.

Now we get an initial temperature of about 2,800 deg. and a flue temperature of about 400 deg. Our boiler capacity is 50 per cent greater than it was before the change-over. A CO_2 recorder and a flue gas temperature recorder enable us to keep close control of combustion.

We have sufficient steam capacity to operate an 18x30 tandem compound engine which drives a 200-kw. generator, a 16x36 Corliss engine driving a 125-kw. generator, and a 16x30x30x18x30x30 cross compounded air compressor. At any time we can supply all the power needed to run our plant.

Whitewash from Carbide Residue

PLANTS that use acetylene welding have found that the carbide residue from acetylene generators may be used to advantage—notably as whitewash.

Made in many times its own weight of water, carbide residue is free from unslaked lime, therefore particularly desirable for use as high grade hydrated lime. Tests of dried residue show that 99.9 per cent will pass through a 300-mesh sieve. The acetylene, on liberation in the generator, has a tendency to crack the ordinary fine grains of the lime into still finer particles. The heat of generation and the excess water in the generator also present ideal conditions for the production of very fine particles.

Also Mortar and Plaster

Outstanding advantage of this fine subdivision is quicker and more efficient action when carbide residue is used to make mortar or plaster. A smaller amount of lime is required because the residue cements the particles of sand together with a thinner coat. This gives a quicker, harder set.

In the chemical field, carbide residue is valuable because of its minute sub-division, also its high calcium, low magnesium content.

Chief among its industrial applications, however, is in making whitewash, for which there are many well-known plant uses.

Formulas for making whitewash have been more or less standardized. Note that when carbide residue is substituted for the hydrated lime element it is well to use half as much again. This allows for the moisture the residue contains (assuming that the residue is of clay-like consistency at the time of use).

The following formulas are offered by the Linde Air Products Company. The first, for interior use, is said to be recommended by insurance companies because of its fire-retarding qualities:

•

FORMULA No. 1
for Interior Use

1. Mix about 120 pounds of carbide residue with water to a creamy consistency.

2. Mix 2½ pounds of rye flour thoroughly with ½ gallon of cold water, then thin with 2 gallons of boiling water.

3. Dissolve 2½ pounds of common salt in 2½ gallons of hot water.

Mix (2) and (3), then add (1), and stir until well mixed.

•

FORMULA No. 2
for Exterior Use

1. Mix about 120 pounds of carbide residue with water to a creamy consistency.

2. Dissolve 2 pounds of common salt and 1 pound of zinc sulphate in 2 gallons of boiling water.

3. Provide 2 gallons of skimmed milk.

Pour (2) into (1), then add (3), and stir well.

•

Alum added to whitewash prevents its rubbing off. A pint of molasses added to 5 gallons of whitewash causes lime to penetrate wood and plaster better. One part silicate of soda or water glass to ten parts whitewash makes what is commonly referred to as "fireproof cement." By adding 1 pound of cheap bar soap dissolved in 1 gallon of boiling water to every 5 gallons of whitewash, a more or less glossy finish is obtained.

Other Uses for Carbide Residue

Other recommended uses of carbide residue in industrial plants include scattering a little on the floor under bearings or in engine pits. It will soak up oil and make it possible to sweep the floor more easily and effectively than by wiping up the oil with waste.

When cleaning and overhauling machinery, carbide residue mixed with water or oil will remove old grease, oil, and rust with little labor. In fact, a similar mixture may be used effectively in polishing all kinds of bright metal.

The water drawn from a carbide residue settling pit or tank has been found of value in purifying drainage pipes, traps of sinks, and other hard-to-reach places.

Mixed with asbestos fiber and sawdust, carbide residue makes a splendid boiler lagging. Mixed with equal parts of fuller's earth, it makes a good heat insulator for small furnaces.

A.C. Wave Windings

Having two and one-half slots per pole per phase should be connected and checked in accordance with these diagrams and tables

A. C. ROE
Railway Engineering Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

IN THE article in the June issue working diagrams, with connecting and checking tables, were given for connecting wave windings having two slots per pole per phase. Windings having 2½ slots per pole per phase will now be taken up, with the use of the checking charts to locate line leads at points other than 120 mechanical degrees apart.

In this article are included connecting diagram Figure 2, Connecting Table II and Checking Chart II, all of which cover 2½ slots per pole per phase. With these and the connecting diagram, table, and chart presented in the preceding article for two slots per pole per phase, the checking charts for both whole and mixed numbers of slots per pole per phase can be covered.

Checking Charts

All of the checking charts are laid out in the same way. The first column lists the total number of slots; the second column, the number of poles. The third column indicates the polarity; the arrow indicates the current flow in each slot in that horizontal line.

Since all the connecting diagrams in this series have the *A1* lead in the bottom of slot *1*, the checking charts are arranged with the A phase at the right, the phases and slot numbers running from right to left. Slot *1* is always the last slot at the left of the A-phase pole group.

The letters to the right of slot *1* in all the charts are used to replace the last slot numbers of each winding, and to permit the proper sequence of numbering.

For example, consider Checking Chart II, six poles, 45 slots. The last slot number under the C-phase group is 43, then $x = 44$, and $y = 45$. These figures also appear under x and y in the first line of the eight-pole section. Thus, a check on slots x and y can be made by dropping to first line of next pole section.

For two, three, four, five, and so on slots per pole per phase the number of slots under the A, B, and C pole-phase groups is always the same, as shown in Checking Chart I in the preceding article. For 2½, 3½, 4½, and so on slots per pole per phase there is always one slot less in every other pole-phase group, as shown in Checking Chart II, which has 3, 2, 3, 2, 3 and so on slots per group. Dropping of a slot is indicated in the tables by a space: so slot numbers with a space indicate odd grouping.

It will be noticed that the slot numbers end at the left of one horizontal line and start at the right in the line just below, or the pole-phase groups are assembled in tiers.

To Find Lead Location

To check for any possible lead location, the proper slots for *A1*, *B1*, and *C1* must first be located. In this series *A1* is always in the bottom of slot *1* with the arrow pointing in; then *B1* must be located in the bottom of a slot at the left of a pole-phase group (see Figure 2) with the arrow pointing out.

When locating leads *A1*, *B1*, and *C1* for 2½, 3½, 4½, and so on slots per pole per phase, the pole-phase group must be one that has the extra slot. Thus, in Checking Chart II the *B1* lead could be located in the bottom of slots *11*, *26*, *41*, *56*, *71*, *86*, *101*, *116*, *131*, *146*, *161*, and *176*, depending on the slots and poles.

The *C1* lead should be located in the bottom of a slot at the left of a C-phase, pole-phase group with the arrow pointing in. In Checking Chart II the bottom of slots *6*, *21*, *36*, *51*, *66*, *81*, *96*, *111*, *126*, *141*, *156*, or *171* could be used.

Connecting Table II*
2½ Slots per Pole per Phase

No. of Poles	No. of Slots	A Phase: Bottom Leads A1	A Phase: Top Leads A*	A Phase: Top Leads A3	A Phase: Top Leads A4	B Phase: Bottom Leads B1	B Phase: Top Leads B*	B Phase: Top Leads B3	B Phase: Top Leads B4	C Phase: Bottom Leads C1	C Phase: Top Leads C*	C Phase: Top Leads C3	C Phase: Top Leads C4	Short Pitch Connection SP 1-3-5	Short Pitch Connection SP 2-4-6
4	30	↑ 1	23	22	15	↓ 11	3	2	25	↑ 21	13	12	5	2	1
6	45	↑ 1	38	37	30	↓ 11	3	2	40	↑ 21	13	12	5	2	1
8	60	↑ 1	53	52	45	↓ 41	33	32	25	↑ 21	13	12	5	2	1
10	75	↑ 1	68	67	60	↓ 26	18	17	10	↑ 51	43	42	35	2	1
12	90	↑ 1	83	82	75	↓ 26	18	17	10	↑ 51	43	42	35	2	1
14	105	↑ 1	98	97	90	↓ 71	63	62	55	↑ 36	28	27	20	2	1
16	120	↑ 1	113	112	105	↓ 41	33	32	25	↑ 81	73	72	65	2	1
18	135	↑ 1	128	127	120	↓ 41	33	32	25	↑ 81	73	72	65	2	1
20	150	↑ 1	143	142	135	↓ 101	93	92	85	↑ 51	43	42	35	2	1
22	165	↑ 1	158	157	150	↓ 56	48	47	40	↑ 111	103	102	95	2	1
24	180	↑ 1	173	172	165	↓ 56	48	47	40	↑ 126	118	117	110	2	1

*See Figure 2 for connecting layout.

Back pitch = 1 and 9; front pitch = 1 and 8; short pitch = 1 and 7.
Coil grouping = 3-2-3-2 and so on.

The connecting charts can be used as a guide for locating the star, No. 3, and No. 4 leads of each phase, under the following rules: The star lead is the bottom conductor in a slot that is one back pitch behind the slot containing the line or No. 1 lead. Consider Connecting Table II in which the back pitch is 1 and 9, or 8. In the six-pole, 45-slot winding, slot *1* is also slot *46*. Then the *A** lead should be in slot *46* — 8 = slot *38;* the *B** lead in slot *11* — 8, or slot *3;* and the *C** lead in slot *21* — 8 = slot *13*. The arrow in the star lead slot should always be of opposite polarity to that of the No. 1 lead for that section; that is, if *B1* is out, *B** should point in to the winding, and so on.

With Even and Fractional Slots

The No. 3 lead *(A3, B3, C3)* is always the top conductor in a slot that is always back of the slot containing the star lead, a number of slots equal to one less than the full number of slots per pole per phase. Thus, for 2 or 2½ slots per pole per phase the No. 3 lead is one slot back of the star lead slot, as Connecting Tables I and II show. For 3 or 3½ slots per pole per phase, the No. 3 lead is 2 slots back of the star lead slot. It will be seen that the fraction is dropped.

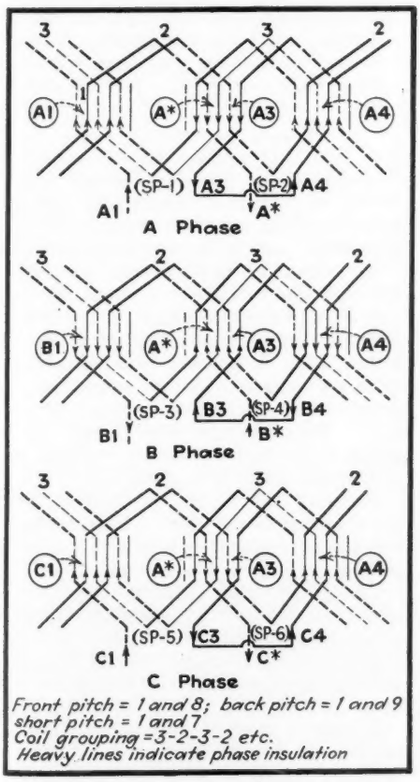

3 2 3 2
A1 A* A3 A4
(SP-1) A3 (SP-2) A4
A1 A*
A Phase
B1 A* A3 A4
(SP-3) B3 (SP-4) B4
B1 B*
B Phase
C1 A* A3 A4
(SP-5) C3 (SP-6) C4
C1 C*
C Phase
Front pitch = 1 and 8; back pitch = 1 and 9
short pitch = 1 and 7
Coil grouping = 3-2-3-2 etc.
Heavy lines indicate phase insulation

Figure 2. Connecting diagrams for a.c. wave windings having two and one-half slots per pole per phase. This diagram is to be used with Connecting Table II

Checking Chart II*

2½ Slots per Pole per Phase

No. of Slots	No. of Poles	Polarity	Phases								
			●	C	●	●	B	●	●	A	●
		↑	6	5	4	...	3	2	1	y	x
30	4	↓	...	13	12	11	10	9	...	8	7
		↑	21	20	19	...	18	17	16	15	14
		↓	...	28	27	26	25	24	...	23	22
45	6	↑	36	35	34	...	33	32	31	30	29
		↓	...	43	42	41	40	39	...	38	[37
60	8	↑	51	50	49	...	48	47	46	45	44
		↓	...	58	57	56	55	54	...	53	52
75	10	↑	66	65	64	...	63	62	61	60	59
		↓	...	73	72	71	70	69	...	68	67
90	12	↑	81	80	79	...	78	77	76	75	74
		↓	...	88	87	86	85	84	...	83	82
105	14	↑	96	95	94	...	93	92	91	90	89
		↓	...	103	102	101	100	99	...	98	97
120	16	↑	111	110	109	...	108	107	106	105	104
		↓	...	118	117	116	115	114	...	113	112
135	18	↑	126	125	124	...	123	122	121	120	119
		↓	...	133	132	131	130	129	...	128	127
150	20	↑	141	140	139	...	138	137	136	135	134
		↓	...	148	147	146	145	144	...	143	142
165	22	↑	156	155	154	...	153	152	151	150	149
		↓	...	163	162	161	160	159	...	158	157
180	24	↑	171	170	169	...	168	167	166	165	164
		↓	...	178	177	176	175	174	...	173	172

***To be used with Figure 2 and Connecting Table II.**
●Indicates slots containing phase insulation.

The checking charts should be used to check the location and polarity of all slots selected for the 12 leads, in conjunction with the connecting diagrams.

These charts can be extended to cover higher slot and pole combinations by continuing the slot numbering and phase grouping. The next highest number of slots for the next number of poles can be found by adding six times the slots per pole per phase. For example, in Checking Chart II, for 26 poles we need 180 + (6 × 2½) = 180 + 15 = 195 slots.

A succeeding article, to appear in an early issue, will explain how the checking charts can be used for coil grouping and phase insulation.

The No. 4 leads, as *A4, B4, C4,* are the top conductors in a slot that is a distance back of the No. 3 lead slot equal to the front pitch. For example, in Connecting Table II the *A4* lead for the six-pole, 45-slot winding is located in slot *37* — 7 = slot *30,* where the front pitch is 1 and 8, or 7, and the *A3* lead is in slot *37*. It should be noted that with a full number of slots per pole per phase, as 2, 3, 4, 5, and so on, the back and front pitches are the same (see Connecting Table 1 in the June issue), whereas for a mixed number of slots as 2½, 3½, 4½, the front pitch is always one less than the back pitch, as Connecting Table II shows.

Questions *and* Answers

Conducted by G. A. VAN BRUNT

Mating Steel and Cast-Iron Flanges

I have been told that when erecting pipe lines it is not advisable to mate a steel pipe flange with a cast-iron flange. Can anyone tell me whether this is true? If so, why? *R.R.—Indianapolis*

UNDER ordinary conditions there is not much cause to worry about mating steel and cast-iron flanges. I have used this combination on many installations, some of which have been in service for more than ten years, without any ill effects. However, the bolts have to be drawn up with some care, in order to avoid possible cracking of the cast-iron flanges.

F. C. RAGG
Assistant Plant Engineer
Textile Dyeing & Printing
Company of America, Inc.
Fair Lawn, N. J.

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Do These Sparks Mean Anything?

While testing a three-phase squirrel-cage motor for grounds by connecting one lead of a 220-volt test lamp to the frame and touching the other lead to the motor leads in turn, the lamp did not light up, but I noticed a slight sparking when either of the test leads was moved. That is, very small sparks showed when either the lead on the motor frame or the one touching the motor leads was moved. Does this sparking indicate that there is a high-resistance ground in the winding? Since the motor seems to operate satisfactorily, would it be safe to put it back in service?
R.B.—Lafayette, Ohio

ALTHOUGH it is possible that the sparking noticed may have been due to faulty insulation, resulting in leakage currents, it is not the only cause, or the most likely one. These sparks may be attributed, I believe, to the flow of a weak current due to the electrostatic capacity between the frame and windings of the motor.

It is probable that it would be safe to put the motor back into service, since it has been operating satisfactorily, although the results of the lamp tests reveal little about the insulation.

To satisfy any doubt regarding the condition of the insulation, a test of the insulation resistance should be made with an insulation resistance meter or voltmeter.

If such a test shows that the insulation resistance is below the generally accepted standard of 1 megohm, it can probably be restored to that value, or made higher, by cleaning and drying the winding and applying one or two dip or brush coats of a good insulating varnish.

J. L. YOUNG, *St. Marys, Ohio*

THE QUESTION indicates that alternating current was used to test the motor. This circuit, having no grounds, would have a high electrostatic capacity and therefore the same characteristics as an a.c. circuit with a condenser connected in series with it. At each alternation the condenser would discharge. When the wire was removed from the frame of the motor a small spark would appear due to these discharges, even though the lamp was not lighted.

In my opinion there is no defect in the windings of the motor, and it is fit for service. However, for the satisfaction and safety resulting from a proper test I recommend that the motor be given a ground test with an insulation resistance meter.

WM. G. LERCHENMILLER, *Bethlehem, Pa.*

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What are your most troublesome problems? Free-for-all discussion of them will help you and other readers

Answers Wanted

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Does Temperature Affect Thermal Overload Relays?

I should like to know whether other readers allow for higher temperatures in summer, when setting thermal overload relays. In our plant the temperature around some motors runs 120 deg. F., or higher and it seems to me that the relays operate more frequently than in winter. It would seem that a high surrounding temperature must have some effect on such relays, so that they would stop a motor on a smaller overload, possibly on loads little above normal. Conversely, it is easy to believe that thermal relays exposed to extreme winter temperatures would permit a greater overload to be carried than in summer. When a motor and its relays are exposed to the same temperature in each case perhaps the surrounding temperature can be neglected. However, some of our starters are exposed to higher, some to lower, temperatures than the motors which they control. What can, or should, be done in such cases?
H.H.—St. Louis

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Overload Protection for Motors

Wiring diagrams for some equipment driven by 3- or 5-hp. motors which we have been installing show that a pressure switch which cuts the motors out at a predetermined pressure contains a thermal overload device that opens only two lines of a three-phase, three-wire, or two-phase, four-wire circuit. Therefore, in the case of a three-phase job one wire of the circuit will be carried straight through to the motor; with a two-phase, four-wire installation, two wires will be solidly connected. Is this protection adequate? G.W.—St. Louis

IT WOULD appear that the equipment being installed comes ready wired, and that the matter of protection has come up from tracing out the blueprint, not from the wiring itself.

If there is always one straight-through line to the three-phase motors, and two to the two-phase, there is not sufficient protection. A ground in either case, or a short between phases in a two-phase winding, might easily result in an abnormal current in one line. There is also the danger of a shock to ground to anyone working on the motor when it is stopped.

Possibly the wiring is correct, but the diagram is not clear. It is unusual to have a pressure switch with thermal protection; more often such a switch open-circuits the holding coil of a magnetic contactor, thermal relays being placed in two lines. When either relay operates it opens the holding coil circuit and allows the contactor to drop out, opening all motor lines.

I suggest that the wiring of G. W.'s machines be checked to determine whether this is what actually happens. If it is not, I think that such a contactor should be wired in, using the pressure switch to control the holding coil circuit.

L. A. HUNT, *Toronto, Canada*

EQUIPMENT NEWS

Starter

Line of small tumbler-type motor starters, both single- and double-pole. Provide protection for motors up to 1 hp., 220 volts a.c., by heater units which are interchangeable. Must be manually reset after overload. Trumbull Electric Mfg. Co., Plainville, Conn.

Circuit Tester

Portable volt-ampere meter combination for a.c. and d.c. readings. Multiple scales reading to 250 amp. a.c. or 300 amp. d.c., and 600 volts a.c. or d.c. Shunts and resistances contained within the steel case which is furnished in baked dark green enamel. Weight, 27 lb.; dimensions, 16x9¼x9 in. The Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland.

Welder

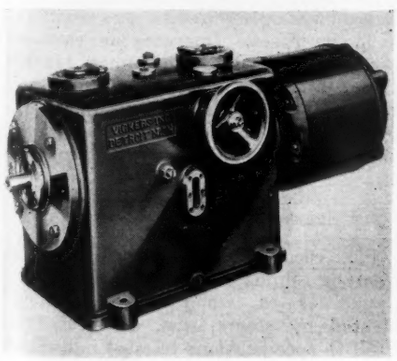
Motor-driven type. Five hp. squirrel-cage motor and generator with 100-amp. rating. Independent adjustment of open circuit voltage and welding current. Wing-nut cable terminals permit easy change of welding polarity. Voltages, 110, 220, 440, and 550; 3 or 2 phase; 60 and 50 cycles. Height, 40 in.; length, 20 in.; width, 16 in. Known as SA-100. The Lincoln Electric Co., Cleveland.

Refractory Cement

Lightweight. Composed chiefly of alumina clay calcined at high temperatures. Weighs 75 lb. per cu.ft. Manufacturer claims negligible shrinkage after continuous operation at 2,400 deg. F. Can be put in service after 12-24 hours air-curing. Known as L. W. Firecrete. Johns-Manville, 22 E. 40 St., New York.

Transmission

Variable speed. Turning of hand-wheel varies stroke and delivery of pump and gives any speed between 5 and 750 r.p.m. Additional adjustments permit speeds up to 2,500 r.p.m. Rotation in either direction; can be supplied with reversing mechanism. Maximum output is 6 hp. continuous duty at 1,000 lb. per sq.in. and 7½ hp. intermittent service at 1,250 lb. per sq.in. Safety valve set at 1,500 lb. per sq.in. Totally inclosed. Dimensions, 25⅞x17⅛ x17½ in. Direct-connected, 1,200-r.p.m. motor. Vickers Inc., Detroit, Mich.



Wattmeter

Polyphase; 2-element; for a.c. and d.c. Rounds out line of instruments. Semi-flush model with over-all diameter of 4¾ in.; projects 1¾ in. beyond front of panel. Rated at 5 amp. and furnished for potentials up to 600 volts. Called "Type FA, 4 in. Polyphase Wattmeter." Roller-Smith Co., 233 Broadway, New York.

Coupling

Flexible. Torque transmitted through resilient cushioning arms of spider subject to compression. Manufacturer claims that life of spider is increased 50 per cent without increasing outside diameter or length of coupling. Three-part construction; sufficient resilience to safeguard connected machines against shocks, overloads, and misalignment. Standard sizes with bores ¾-3 in.; ½-200 hp. at 1,750 r.p.m. L-R Type "IA." Lovejoy Tool Works, 4963 W. Lake St., Chicago.

Bearings

Three types of precision ball bearings designed for high-speed use where extreme accuracy is required. Single-row radial design with both rings and balls of high-carbon chrome steel. Type "M" in all standard sizes. Type "WW," available in bore sizes 17-55 mm., has ring-piloted bronze retainer to assure concentricity in operation. Type "MM," designed for high-speed machine applications, has special composition retainer for lightness in weight; comes in sizes 10-110 mm. The Fafnir Bearing Co., New Britain, Conn.

Circuit Breaker

Oil blast. Rated 600 amp., 7,500 volts; 800 amp., 2,500 volts; and 25,000-kva. interrupting rating. Double- and triple-pole, single throw with all poles in single, welded plate steel tank. May be manually or electrically operated. Silver-to-silver main contacts protected by arcing contacts. Oil blast baffles. For mounting back of panels, in switch houses, or in metal-inclosed switchgear. Type FK-42. General Electric Co., Schenectady, N. Y.

Gasket

Line of drop-forged, iron-ring gaskets for grooved joints. Designed for high-pressure and high-temperature lines. Sizes 2½-14¾ in. Also made to specification in acid-resisting metals. Called "Gruv-Seal." The Steel Improvement & Forge Co., 960 Addison Rd., Cleveland.

Switch

Drum type, reversing. For a.c. or d.c.; across-the-line type. Manufacturer claims that arcing parts are designed for long wear and are easily renewed. Furnished in standard inclosure or as skeleton drum with mounting plate. Ratings: for single

phase, 1 hp., 110 volts; 1½ hp., 220 volts—for d.c., 1 hp., 115 or 230 volts. Eight-hour rating, 15 amp. Cutler-Hammer, Inc., 429 N. 12 St., Milwaukee.

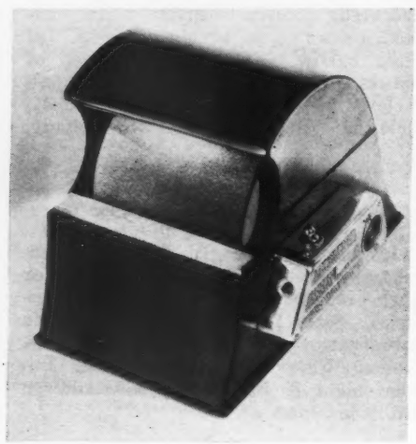
Regulator

Type "SS" submerged induction. Has basic features of larger "S" type, but is simplified to reduce cost so that it can be applied to small-capacity cir-

cuits. Electrical position indicator is calibrated to indicate regulator position when regulator is excited. No lubrication and little attention required. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Surfacing Machine

Portable. Housing styled along modern lines and available in different colors. Light concealed in cover illuminates the work. Dust-proof motor of ¾ or 1 hp. contained within revolving



drum upon whose cushioned surface abrasive and polishing sheets are used. For 110 or 220 volts, 60 cycles a.c. Weight, 50 lb.; dimensions, 14½x10x 10½ in. Trimson Mfg. Co., 3030 Euclid Ave., Cleveland.

Motors

Line of squirrel-cage, normal- and high-torque motors designed for refrigeration and air-conditioning applications. Sleeve or ball bearing designs. Sizes up to 600 hp. Century Electric Co., St. Louis, Mo.

Batteries

For starting diesel engines of 25-600 hp. Designed for currents of 300-1,600 amp. and voltages of 12-115, at low temperatures. Heavy-duty, hard rubber monobloc containers and heavy, flexible, lead-plated copper connectors between cells. The Electric Storage Battery Co., Allegheny Ave. and 19 St., Philadelphia.

Pipe

Cast iron. For water and gas lines. Suitable for water pressures of 175 lb. per sq.in. Lengths, 5, 10, 15, and 20 ft. Threaded joints. Expansion joints for insertion at 80-100 ft. intervals. Sizes, 1¼-6 in. Minimum bursting pressure for 1¼-in. size, 7,000 lb. per sq.in.; for 6-in. size, 1,500 lb. per sq.in. Called "Hi-Test." Walworth Co., 60 E. 42nd St., New York.

Fuse Cabinet

Switched-fuse type, called "Switch-Centers." In 4, 8, and 12 circuits single-phase and 8 and 12 circuits 3-phase, 4-wire. Toggle switches of 30 amp. capacity are removable without removing cabinet front. Bull Dog Electric Products Co., 7610 Jos. Campau Ave., Detroit.

Valves

Diaphragm. Called "TAG Long Range Throttling Top." Spring pressure may be varied by adjusting feed screw which moves against spring in such manner that there is no wind-up of the spring. Sizes, 7½, 9⅝, and 11¾ in. over-all diameter. C. J. Tagliabue Mfg. Co., Park and Nostrand Ave., Brooklyn, N. Y.

Grinder

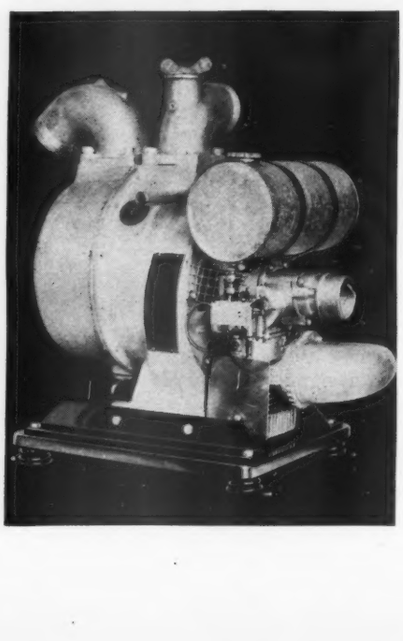
Bench. For light tool grinding jobs. Double end, 7x¾-in. wheel, with ⅓-hp. motor. Made for 115 and 230 volts d.c., and for single-phase a.c., is equipped with split-phase motor. Squirrel-cage motors with grinders for 3-phase, 220 and 440 volts. The Hisey-Wolf Machine Co., Cincinnati.

Tubing Cutter

For cutting copper and brass tubing. Hand-operated screw turns in housing to move twin-piece saddle toward cutting wheel. Weight, 6½ oz.; length, 5½ in. Will cut tubing up to 1 in. outside diameter. The Ridge Tool Co., Elyria, Ohio.

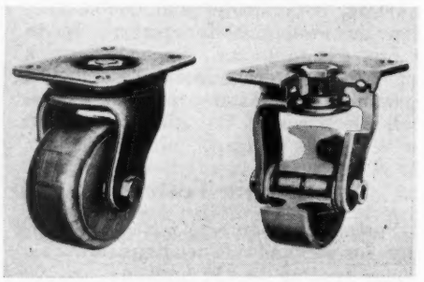
Pumps

Double suction, centrifugal. Four series to handle heads up to 300 ft. Impellers and impeller rings of bronze. Casing and casing rings of cast iron. Casing is split on horizontal center line to permit access to interior. Shaft



of alloy steel. Heavy-duty ball bearings are inclosed in splashproof and dustproof housings. Shaft sleeves of cast bronze. Gardner-Denver Co., Quincy, Ill.

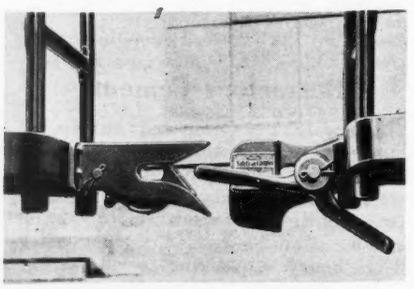
Casters



Die-forged steel with wood or forged-steel wheels. Guaranteed by manufacturer to be unbreakable. Single forging with threaded stud forms lower ball race and anchors to top plate. Cold-rolled steel axle ⅝ in. in diameter. Wheel diameters: 4, 5, and 6 in. The Metzgar Co., Inc., Grand Rapids, Mich.

Coupler

For trailers. Automatic. Flat-top jaw is installed flush with trailer deck, offering no obstruction to overhanging load. Pressure of foot on side pad releases latch dog which moves downward to open. Latch spring entirely inclosed. No need for operators to go



between trailers. Mercury Mfg. Co., 4119 S. Halsted St., Chicago.

Indicator Lamp

Tiny neon lamp tells when electric appliances are operating. Can be used to indicate open circuits and switches or blown fuses. Operates on voltages 90-250 a.c. or d.c. Consumes 1/1,000 amp. Has 3,000-hour life. Can be had in panel type mountings. Littelfuse Laboratories, 4507 Ravenswood Ave., Chicago.

Stills

For recovery of solvents used as cleaning fluids or lacquer thinners. Capacities of ½-500 gal. per hour. Heated by steam, gas, or electricity. Built to specifications to meet individual

requirements. Materials dependent upon chemical characteristics of liquids involved. Easily cleaned. Barnstead Still & Sterilizer Co., Inc., 2 Lanesville Terrace, Forest Hills, Mass.

Pump

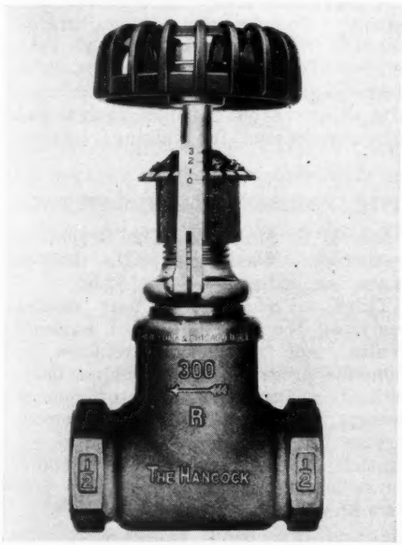
Portable; weighs 88 lb. complete with built-in, air-cooled, gasoline engine. Self-priming, centrifugal; capacity, 15,000 gal. per hour; suction lift of 28 ft. Can handle muddy water containing solids. Main parts of aluminum alloy. Homelite Corp., Port Chester, N. Y.

Bucket Loader

Main frame tied into integral unit by use of tank type chassis. Parallelogram axle has 3-point suspension. Synchronized feeding and automatic reset overload release. "Floating Boom" lets crowding thrust go directly from crawlers to feeding end. Welded, high-backed buckets with hard facing on lips. Slow crowding speeds. Model 82. Barber-Greene Co., Aurora, Ill.

Valve

Called "Flocontrol." Has micrometer adjustment reading to 1/10 of a turn. Quantity of flow directly proportional to number of turns. Globe and angle types in sizes ⅜-2 in. for pressures up

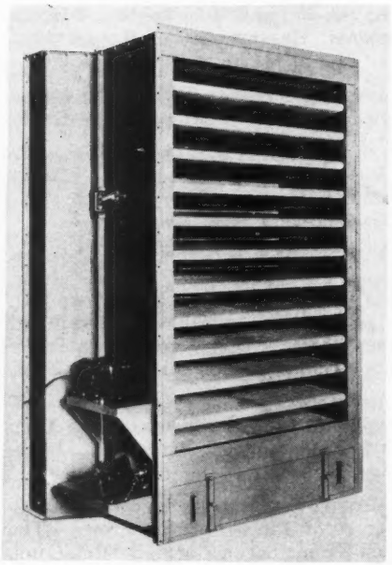


to 300 lb. Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn.

Coupling

For pipe. Put on with wrench without threading. Coupling body houses two gaskets which form a seal as coupling is tightened on each side of the joint. For pipe sizes ⅜-2 in., inside diameter. S. R. Dresser Mfg. Co., Bradford, Pa.

Air Filter



Woven cotton fabric, mounted as endless belt, filters dust particles. Motor of ⅛ hp. revolves roller and lowers dust-filled area to bottom of filter where beater actuated by ¼-hp. motor shakes dust off into tray. Tray must be cleaned 3 or 4 times a year; curtain must be moved once a day or less. Manual control unless automatic equipment is specified. Motors operate on 110 or 220 volts, d.c. or single-phase a.c. of 25, 50, or 60 cycles. Coppus Engineering Corp., Worcester, Mass.

Electric Hammer

Simple adjustment adapts tool for drilling and light grinding. Two working parts of steel. Universal motor. As hammer, will drill holes up to 1⅜ in. diameter. Called "Do-All." Wodack Electric Tool Corp., 4627 W. Huron St., Chicago.

Controller

For controlling temperature, pressure, rate of flow, or liquid level, where a predetermined differential must be maintained between two variables. Primary variable is recorded as well as controlled secondary. Direct and inverse adjustments to a maximum ratio of 5:1. May be mercury-, vapor-, or gas-actuated for temperature applications. Control maintained by regulating air pressure on diaphragm valve. Pressure of 25 lb. per sq.in. used. Aluminum casing, finished in black or white, for face- or flush-mounting. Taylor Instrument Co's., Rochester, N. Y.

Barrel Pump

Air-operated. Can be attached to any 100-lb. lubricant container. Low-pressure pump carries lubricant from container to high-pressure pump which delivers 18 oz. of regular or 6½ oz. of heavy lubricant per minute. Called "HP-100 — High Pressure Barrel Pump." Alemite Corp., Chicago.

Insulating Cement

Called "Sonittep Insulating Cement." Will withstand temperatures up to 2,000 deg. F. Can be applied to hot or cold surfaces; requires no reinforcement. Can be applied by unskilled labor. May be reclaimed and used a second time. Mineral wool base. George F. Pettinos, Inc., 1206 Locust St., Philadelphia.

Balancer

For balancing loads up to 200 lb. at any point in the range of travel. Tapered drum; inclosed housing. Safety device locks drum if spring breaks. Swivel ball-bearing hook. Cable guide; spring adjustment. Four of 13 sizes have locking and unloading device. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.

TRADE LITERATURE

AGITATOR — Folder, describing "Shaler Shaker," as a vibrator for conveyor screens.—Ajax Flexible Coupling Co., Westfield, N. Y.

AIR CONDITIONING—Folder, on propeller-type, suspended coolers. — The Trane Co., La Crosse, Wis.

BALANCER—Leaflet, showing line of balancers for loads up to 200 lb.—Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.

BEARINGS — Catalog, giving dimensions, load data, and prices of ball bearings.—The New Departure Mfg. Co., Bristol, Conn.

CABLES — Booklet GEA-1839, title "Cable Accessories."—General Electric Co., Schenectady, N. Y.

CASTERS—Folder, announcing steel-forged casters.—The Metzgar Co., Inc., Grand Rapids, Mich.

CIRCUIT TESTER—Folder, announcing Model No. 3-DA circuit tester.—The Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland.

COMPRESSORS—Bulletin L-621-B6, on Type VS, single-stage, vertical, single air compressors.—Worthington Pump and Machinery Corp., Harrison, N. J.

COMPRESSORS — Catalog, showing Type XPV steam-driven compressors. —Ingersoll-Rand Co., 11 Broadway, New York.

COMPRESSORS AND PUMPS — Form 7502-D, covering line of compressors and vacuum pumps. — Ingersoll-Rand Co., 11 Broadway, New York.

CONDUIT—Bulletin No. 351, on underground steam conduit system "Thermo-O-Tile."—H. W. Porter & Co., Inc., Newark, N. J.

CONVEYORS — Booklet, showing applications of chain and belt conveying. —Chain Belt Co., Milwaukee.

CONVEYORS — Folder No. 1414, on portable belt conveyors. — Link-Belt Co., 910 S. Michigan Ave., Chicago.

COUPLING—Folder, announcing Type 65 compression coupling.—S. R. Dresser Mfg. Co., Bradford, Pa.

CRANE — Folder, showing electric overhead traveling crane.—Erie Steel Construction Co., Erie, Pa.

CRANE WHEELS—Leaflet, on double-wall, crane track wheels.—American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.

DRAWN STEEL—Folder on cold drawn steels.—Union Drawn Steel Co., Massiloln, Ohio.

FANS—Folder, showing line of electric fans.—Century Electric Co., 1806 Pine St., St. Louis.

FILTER — Bulletin F-350-1, showing automatic self-cleaning filter.—Coppus Engineering Corp., Worcester.

FIRE EXTINGUISHER—Folder 460, describing hand-size carbon dioxide extinguisher. — Walter Kidde & Co., Bloomfield, N. J.

FLOOR PLATE—Folder, describing 4-way floor plate.—Inland Steel Co., First National Bank Bldg., Chicago.

FURNACE—Bulletin No. 40, on gas-heated, convected-air, tempering furnace.—Despatch Oven Co., Minneapolis.

GAS BURNERS—Price list of line of gas burners.—The Barber Gas Burner Co., 3702 Superior Ave., Cleveland.

GRINDER—Folder, showing 6x18 in. surface grinder.—Norton Co., Worcester.

HEATER — Bulletin No. 35-75, on storage water heaters.—American District Steam Co., North Tonawanda, N. Y.

INSULATION — Folder, describing a plastic insulating material.—Wyo-Lite Insulating Products Division, Wyodak Chemical Co., 4600 E. 71st St., Cleveland.

MOTORS — Bulletin No. 601, title "Motors for Centrifugals."—The Louis Allis Co., Milwaukee.

MOTORS — Two bulletins, on "Varidrive" and "Syncrogear" motors. — U. S. Electrical Mfg. Co., Los Angeles.

NOZZLES — Bulletin No. 50, contains data on spray nozzles.—Binks Mfg. Co., 3114 Carroll Ave., Chicago.

PHOTOELECTRIC CELL—Booklet, title "The Electric Eye in Theory and Practice." — Hugh H. Eby, Inc., 2066 Hunting Park Ave., Philadelphia.

PIPE — Folder, showing "Hi-Test" cast iron pipe.—Walworth Co., 60 E. 42nd St., New York.

POWER UNITS — Five folders: on diesel; PA-40, 6-cylinder, variable speed; Model 200 heavy-duty, 4-cylinder; PA-50; and P-30 engines.—International Harvester Co. of America, Inc., 606 S. Michigan Ave., Chicago.

PUMPS — Folder, on single-stage, split-case, centrifugal pumps. — Gardner-Denver Co., Quincy, Ill.

PUMPS—Leaflet 2199, title "A Useful Pumping Unit for Every Industry."—Allis-Chalmers Mfg. Co., Milwaukee.

PUMPS—Two bulletins: W-102-B1 on Type TB, horizontal, duplex piston pumps; W-321-B2A, on Group D, single-stage, monobloc centrifugal pumps, sizes 1-1½.—Worthington Pump and Machinery Corp., Harrison, N. J.

RESISTOR — Folder, describing LV "Ohiohm" carbon resistors.—The Ohio Carbon Co., 12508 Berea Rd., Lakewood, Ohio.

SCREWS — Catalog, describing manufacture of Fibro Forged Screws.—The Holo-Krome Screw Corp., Bristol, Conn.

SHIPPING EQUIPMENT — Booklet, showing devices for packing and shipping.—Paslode Co., Merchandise Mart, Chicago.

SPRAY PAINTING—Catalog No. 535, on ceramic spray equipment.—Binks Mfg. Co., 3114 Carroll Ave., Chicago.

STEAM TRAPS—Catalog G, Third Edition, on steam traps.—Armstrong Machine Works, Three Rivers, Mich.

STEEL SPECIFICATIONS — Leaflet, giving steel specifications.—The Timken Steel & Tube Co., Canton, Ohio.

STILLS—Folder, showing solvent-recovery stills. — Barnstead Still & Sterilizer Co., Inc., 2 Lanesville Terrace, Forest Hills, Mass.

SWITCHES — Bulletin GEA-2127, on Types LP-1 and LP-Y1 knife switches. —General Electric Co., Schenectady, N. Y.

SYNTHETIC RUBBER—Folder, on oil-proof synthetic rubber and rubber cement. — Thiokol Corp., Yardville, N. J.

TRANSMISSION—Leaflet, on hydraulic, variable-speed transmission. — Vickers Inc., 1400 Oakman Blvd., Detroit.

TUBING CUTTER — Leaflet, showing hand-operated cutter for copper tubing. —The Ridge Tool Co., Elyria, Ohio.

VALVE—Folder, announcing "Flocontrol" valve with micrometer adjustment.—Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn.

VALVES—Bulletin No. 1117, on diaphragm valves.—C. J. Tagliabue Mfg. Co., Park and Nostrand Ave., Brooklyn, N. Y.

WRENCH—Form 2152-A, announcing air-cooled, reversible, impact wrench.—Ingersoll-Rand Co., 11 Broadway, New York.

On the Calendar

AUGUST

——**November 11. California Pacific International Exposition, San Diego. Headquarters, Administration Bldg., Balboa Park, San Diego.**

20-23, American Foundrymen's Association, annual convention, Toronto, Canada. C. E. Hoyt, executive secretary-treasurer, 222 W. Adams Street, Chicago.

28-31, Eighteenth Annual Conference on Industrial Relations, Silver Bay on Lake George, N. Y. Auspices of The Industrial Department of the National Council of Y. M. C. A.'s in cooperation with a committee of industrial men. E. C. Worman, secretary, 347 Madison Ave., New York.

SEPTEMBER

3-6, Illuminating Engineering Society, annual convention, Cincinnati. D. W. Atwater, general secretary, 29 West 39th Street, New York.

11-21, National Machine Tool Builders Association, exposition, Cleveland. W. P. Kirk, chairman, Exposition Committee, 1220 Guarantee Title Bldg., Cleveland.

NOVEMBER

12-15, International Acetylene Association, 36th annual convention, Cleveland. H. F. Reinhard, secretary, 30 E. 42d Street, New York.

DECEMBER

2-7, 15th Exposition of Chemical Industries, New York. Headquarters, Grand Central Palace, New York.

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Books

CAST METALS HANDBOOK

American Foundrymen's Association, 222 W. Adams Street, Chicago. 500 pages. $3 until August 1, $4 after that date.

A reference book for engineer, designer, foundryman, metallurgist, technical consultant. Covers all four general classes of cast metals—steel, malleable, nonferrous, and gray iron. Also chapters on castings design and recommendations for castings buyers.

•

THE FORMATION OF CAPITAL

Harold G. Moulton. The Brookings Institution, Washington, D. C. 160 pages, appendixes, index. $2.50.

Third in a series of four studies analyzing the distribution of national wealth and income in relation to economic progress. This volume deals with the transformation of money savings into capital equipment, demonstrates the dependence of capital expansion upon consumptive demand, shows how excessive savings may produce financial disorder.

•

ACCOUNTING PROCEDURE FOR STANDARD COSTS

Cecil Merle Gillespie, assistant professor of accounting, Northwestern University. The Ronald Press Co., 15 E. 26th St., New York. 371 pages, looseleaf. $5.

Explains principles of the three fundamental methods of operating standard costs, illustrates their application to actual operating situations. Consists of 15 lectures developing prin-

(Continued on advertising page 60)

For Motors, This Maintenance

(*Continued from editorial page 307*)

•

Brush springs should be adjusted to give uniform tension. The brush pressure should be from 1 to 2½ lb. per square inch of contact surface. Collector ring surfaces require pressures of 4 to 5 lb. per square inch.

Tension may be checked by hooking a small spring scale under the brush shunt and pulling it in a direction parallel to the brush-holder until the brush just leaves the commutator or ring surface. Too much tension causes excessive wear and grooving of the surface and high friction loss. Insufficient brush pressure results in unbalanced circuits, poor voltage regulation, and sparking.

The brush rigging should be checked for tightness and cleanliness. Loose studs or holders should be made tight. All parts, particularly the insulating washers and bushings, should be kept free from dust.

Rings Clean, Free from Corrosion

Collector and slip rings do not as a rule give much trouble. Grooving of the surfaces and the development of flat spots are probably the most common troubles. To prevent them the brushes should be spaced exactly 180 or 90 degrees apart and so placed as to bear on all portions of the ring surface as nearly equally as possible. It is also important to make sure that the rotor is not unbalanced and that the rings run perfectly true. Pitting, rusting, and tarnishing of the surfaces is frequently the cause of flat spots; it is, therefore, necessary to keep the rings clean and free from corrosion.

With synchronous machines if one ring wears away more rapidly than the other the field connections at the rings should be reversed. If the rings become grooved, rough, or out of true, they should be turned down and polished.

Ring-insulating washers and bushings should be regularly examined to see that they are clean and intact.

A check of bearing wear and lubrication is one of the main items on any maintenance program. Much unnecessary bearing wear can be prevented by giving proper attention to lubrication. Ring-oiled bearing reservoirs should be drained, flushed out with kerosene or flushing oil, and refilled with a good grade of well-filtered mineral oil every six months when the machine operates under average conditions. More frequent changing of the oil is necessary when motors operate in a dusty atmosphere.

Bearing reservoir covers and filler caps should be kept in place to prevent the entrance of dust and other abrasive matter. Oil rings should be inspected when the machine is started up to make sure that they are turning.

Air gap clearance should be measured by a feeler gage at not less than four different points around the periphery of the rotor or armature, to determine whether it has dropped from its concentric position. Such feeler gages can be obtained at small cost from tool manufacturers or from the maker of the machine. Bearing wear on squirrel-cage rotors and other machines that have relatively small air gaps can most easily be checked by air gap measurements. If the clearance at the bottom or in the direction of belt pull becomes so close that there is danger of the rotor rubbing or striking the stator, the bearings should be renewed. Too great inequality of air gap clearance may also result in magnetic unbalance.

Bearing failures are sometimes due to having the belt too tight, shaft currents which pit the journals and bearing linings, defective oil rings or broken balls or rollers, loose bearing linings, misalignment, and too much end play or thrust.

Frame and endbell housings or bearing brackets should be examined for cracks. All bolts should be checked for tightness. Rusted or corroded surfaces should be wire-brushed and given one or two coats of a good anti-corrosive paint.

On a motor subjected to shocks or sudden reversals, the rotor or armature core may work loose on the shaft. This looseness is usually difficult to detect but such motors sound as though they were out of balance. A characteristic sympton on a d.c. motor is the occasional finding of one or two broken commutator risers.

Ventilating fans that are riveted or bolted to the rotor should be hammer-tested for tightness and soundness. Several bad failures of a.c. motors and generators have been caused by fan blades breaking off or becoming loose and cutting the stator end turns.

Inspect Motor When Running

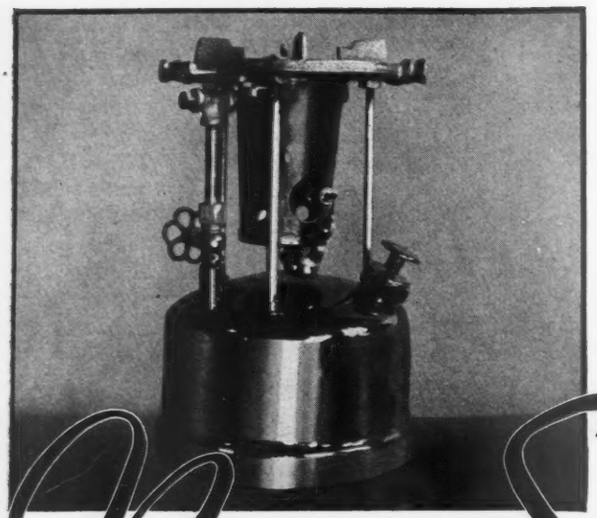
The foundations or supports should be firm and all holding-down bolts should be tightly drawn up.

No inspection of a motor or a generator is complete without observing it in operation under normal service conditions. Winding and bearing temperatures are the most important points to check. Excessive heating of the windings or other parts should be thoroughly investigated. Insulating materials are carbonized or roasted by high temperatures. Any temperature above 120 deg. F. is uncomfortable to the hand, but the hand is a poor thermometer and should not be relied upon, except as a general guide. Measurements should be made by thermometer on machines running at a high temperature. The thermometer may be held in position by tape or putty or by felt pads cemented to the machine. Windings should never exceed a temperature of 80 deg. C (176 deg. F.) when measured by a thermometer.

"A well-planned maintenance schedule, with regular and thorough inspection, pays dividends in reduced operating costs and machine breakdowns"

A temperature of 100 deg. C. is usually considered the maximum safe operating limit for the stator windings of turbo-generators of the usual design, when measured by embedded detectors or thermocouples. On such machines rotor heating is usually the limiting feature and it is, therefore, important to check the field current, power factor, and phase unbalance at each running inspection. So long as the field current and power factor are respectively below and above the value shown on the name-plate, and the phase unbalance does not exceed 5 per cent at full

(*Continued on page 55*)



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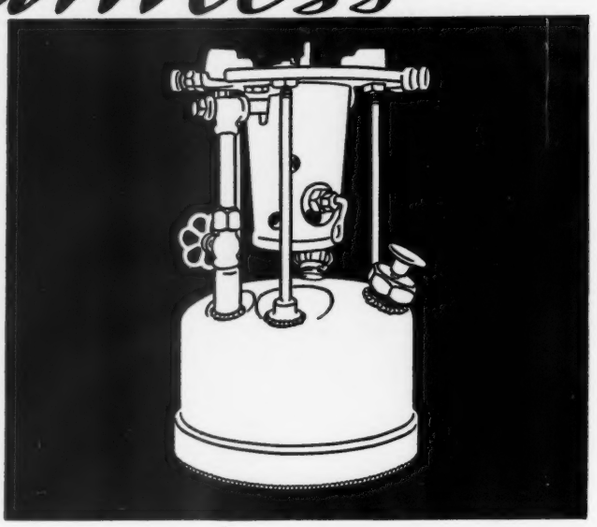
● In the better gasoline or kerosene furnace, soldered seams have been eliminated. A new standard has been set. Jointless construction, so easily accomplished by welding, has given this furnace competitive advantages in performance, durability, safety, and appearance. These advantages mean greater *salability*.

The evolution of this improved gasoline furnace was through a widely recognized application of welding.

Welding has made many good products better—refrigerators, automobiles, radios, streamlined locomotives, metal furniture, and a thousand other things. You may find it profitable to consider the advantages in both production and sales which can be gained for your product by jointless design-for-welding.

When you decide to do this, take advantage of the wide experience of the Linde organization in design and welding fabrication. Linde Process Service will make this experience available to you. You can arrange for this service—as a hundred thousand other business organizations have—by telephone, by telegraph, or by mail, to the nearest Linde Office.



● ***Oxwelding was an important factor in the evolution of this better furnace. Soldered seams gave way to strong, jointless construction; possible only with welding.***

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FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

(Continued from page 53)

load, no excessive heating of the rotor should result.

It is good practice to measure the voltage and current imput to motors at periodic intervals, to determine whether they are being operated efficiently. The speed should also be checked at the same time. With squirrel-cage motors the speed is a good indication of the load.

Rotating electrical machines should run smoothly and quietly. Noisy operation may be due to any of the following: Loose or worn bearings; loose coils or wedges; vibration; brush chatter; loose armature or rotor core; unbalanced armature or rotor; loose laminations; or improper design. Development of an unusual noise is, in a great many instances, a sign of trouble and should be fully investigated.

Causes of Excessive Vibration

Excessive vibration may be caused by misalignment, unbalance, poor bearing adjustment, a bent shaft, or a full or partial ground or short circuit in the rotor or armature. The many bad effects of excessive vibration are well known; such a condition should be corrected with the least possible delay. Coil failures are frequently brought about by a combination of insulation shrinkage and abnormal vibration. The coils, being loose, move sufficiently to wear the insulation away to the breakdown point.

Synchronous converters and d.c. generators that are part of motor-generator sets are usually protected against overspeeding by speed-limit devices, reverse current relays, or by a trip coil on the d.c. circuit breaker which will open this breaker if the a.c. power fails. Such devices should be tested regularly and if a speed-limit device is used the tripping speed should not exceed 15 per cent of the rated speed of the machine.

There are many other important features of motor and generator inspecion and maintenance that cannot be discussed here. Operating conditions vary so widely that it is practically impossible to set up maintenance and inspection standards applicable to all industries.

The important point to remember is that a well-planned maintenance schedule, with regular and thorough inspection, pays dividends in reduced operating costs and breakdowns.

The Conditions Audit

(Continued from editorial page 281)

•

partment together with a covering letter.

(b) Each department head shall at once bring all reported non-standard conditions up to standard and report exactly what he has done in writing on the report itself to his Division Chief by the end of the third working day after the date of the covering letter.

(c) Each Division Chief shall check each department head's returns and see that they are received by the "end of the third working day after the date of the covering letter," and, in each case, that the department head's action is adequate and satisfactory.

(d) Not later than the 20th of the month following the month during which the inspection was made, each Division Chief shall send all department heads' returns with any necessary comments to the Chairman of the Audit Committee.

Effective: These provisions shall be effective with the inspection that shall be made in the month of January, 19—.

Changes: Desirable changes or improvements in this plan of audit shall be called to the attention of the Industrial Engineer.

Results Secured

The rating percentages assigned to departments by the committee were somewhat arbitrary but were carefully determined and consistent month by month and department by department.

The plant average for the first year of the conditions audit was 78.52; the second year, 88.63; the third year, 94.54; and the fourth year, 97.58 per cent. The fourth year showed an improvement of 24 per cent over the first year. These figures reflected a corresponding genuine betterment of conditions in the plant as a whole. Departments below average when the audit was started improved most. The audit noticeably improved conditions in the best departments but tended singularly to introduce into the poorer departments many of the improvements that existed only under the livest, most energetic, and capable foremen when the audit was started.

The audit committee wielded no supervision, assumed no operating responsibility, and detracted not at all from the authority and responsibility of department heads. Its action consisted wholly of appraisal and suggestion which stimulated all operating heads, both foremen and superintendents, to improve their supervision so as to anticipate possible criticism or suggestion by the audit committee.

The presence on the committee of the resident industrial engineer gave him simultaneous contact in all departments of the business; enabled him to continue effective watchfulness over those departments in which his department had made installations, to project his scrutiny into those departments in which improvements were scheduled but not yet installed; and compelled him monthly to pass all other departments under his critical examination—which provided sources of competent, impersonal, immediate recommendations that did not offend but brought to his attention for future action weaknesses which would not otherwise have come to light so quickly.

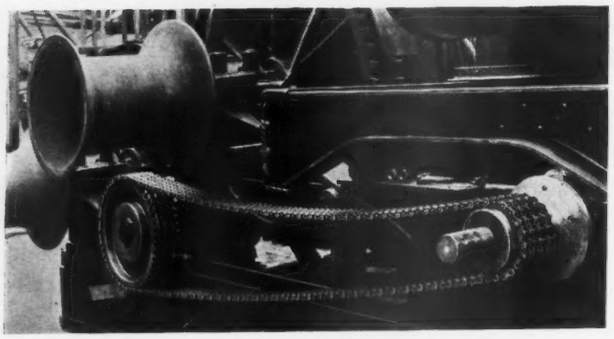
These outstanding features contributed to the results secured:

Personnel of Committee: The audit was made by three men, each of whom had for years been familiar with the plant as a whole. Each was recognized by all department heads as able and impartial, and each in his regular position reported only to the president, which removed most of the incentive to play plant politics.

Regularity: The audit was made regularly. Never was press of other work allowed to interfere. Foremen soon learned that it was regular, fair, and impartial, but thorough and not to be fooled.

Report in Writing: Every criticism was made in writing. Every correction of criticized conditions was reported in writing by the foreman of the department criticized. This tie-up compelled quick and specific action which could not be dodged by busy, careless, or vacillating division chiefs or foremen. In every case where operating heads disagreed with the committee's findings, the matter was thrashed out in conference and a definite conclusion reached.

Executive Support: The audit had the hearty, unwavering support of the highest officer of the company. He never interfered, however, except in the rare cases when audit reports failed to receive prompt action or when matters were appealed to him either by division chiefs or the audit committee.



A

Suggestion . . FOR EXPOSED DRIVES

The elements don't bother a properly designed roller chain very much. Many Baldwin-Duckworth machine finished steel roller chains, like the one in the illustration have defied fog, rain, snow, dust and mud for *years*. Their superiority to other types of drives for such exposed service does not only lie in their being 99% efficient but in their resistance to atmospheric changes, to extremes of heat and cold which adversely affect other power transmission mediums.

Baldwin-Duckworth's careful manufacturing processes produce precision bearing surfaces, which when properly lubricated, will result in long life. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

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Genuine Pyroil is protected by U. S., Canadian and foreign patents issued to W. V. Kidder, its inventor. Look for this signature on every can.

When You Select Cable

(Continued from editorial page 306)

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take the cheapest new cable, even used cable, because it would be torn out in a few months. Processes in some industries and certain equipment in others cannot tolerate interruptions in power service; hence every precaution, including the best obtainable cable, is taken to insure continuity. A very expensive piece of equipment, say a car dumper handling 80 100-ton cars per hour, requires only a small amount of cable. Interruptions cannot be tolerated; the cable cost is but a small part of the total and only the best is considered.

Consider Use Schedule

The schedule of use for cables must be considered. Cables that are under load all of the time need less protection from dampness than those in use only part of the time, as at icebound lake or ocean ports. Where cables are being worked to capacity 100 per cent of the time, as on power station auxiliaries, duplicate runs may be justified. On the other hand, an 8-hour-per-day service schedule allows overhauling and replacements to be made without production delays.

Cable may be run in conduit, either the solid or the flexible type. Or it may be run on outdoor poles, along walls in dry rooms, in damp tunnels, in the ground, or under water. These locations have a marked effect on size, finish, and cost. Good engineering involves the quality-cost combination that is most effective for a given installation.

Some industries are characterized by the acreage covered in proportion to the amount of power used—others by the number of power units in proportion to the space covered. The wide-spread plant requires more cable, and it has to be somewhat larger to keep down voltage drop. Textile plants, for example, have thousands of small motors spread over acres of ground, whereas the power equipment on an electric shovel is packed in just as small a space as possible.

Facilities and personnel to handle installation are also factors in cable

Roll-Up Economies with KINNEAR DOORS

Kinnear has long been the by-word for door economies. Rolling upward they save valuable floor and wall space. Accurately counterbalanced they operate with ease, speed and dependability . . . reducing factory overhead. But more important still, their ingenious design and rugged construction means lower maintenance cost . . . evidenced by 30 year old Kinnear doors still in daily service. Built in several different types there's a Kinnear for every purpose.

Kinnear types: wood or steel Slat Rolling, wood or steel Bifolding and wood or steel Rol-Top (sectional overhead type).

Let us submit recommendations for your door needs.

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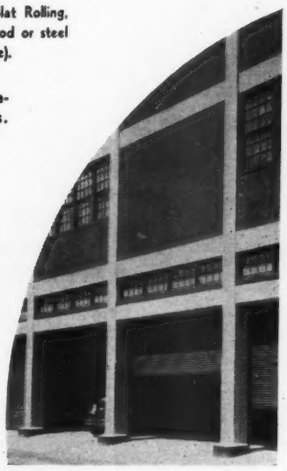

Showing a battery of the famous Kinnear Interlocking Slat Steel Rolling Doors. When desired primarily for fire protection they may be labeled by the Underwriter's Laboratories, Inc.

MODERN DESIGN

An all-steel frame . . . four bearings (Timken) . . . sparkless commutation and unusual accessibility . . . such features as these make possible the extra quality and extra service of Columbia low-voltage generators. They

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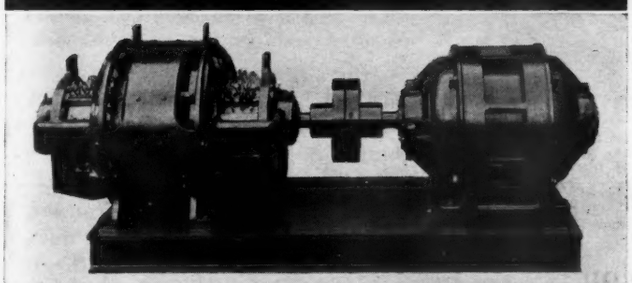


Good Plating Rooms Deserve

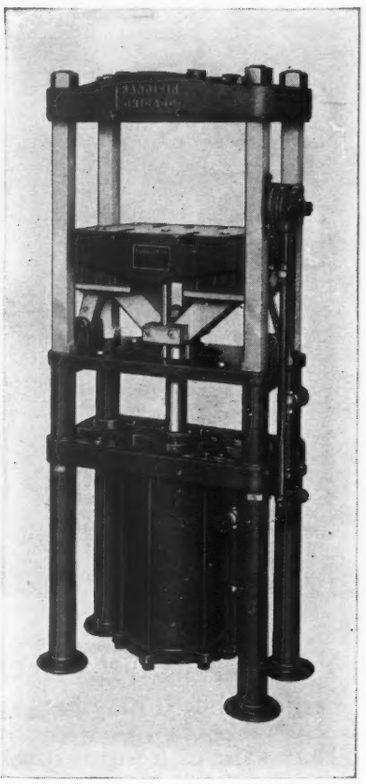
are built in sizes of from 100 to 20,000 amperes for plating room and all kinds of low-voltage service. Complete synchronous or induction-type motor generator sets can also be furnished.

THE COLUMBIA ELECTRIC MFG. CO.
4515 Hamilton Ave., CLEVELAND, O.

COLUMBIA
LOW VOLTAGE GENERATORS and RHEOSTATS

A new WAY . . .

to cut moulding costs



BECAUSE this new platen press is air operated, compact, and comparatively light in weight it brings new economies to plastic and rubber moulding operations. It permits installation of a moulding department (or the modernization of present facilities) with a moderate investment and economical operating expense. Present production requirements may be suited exactly, and future expansion provided at moderate cost.

This press is adapted to both hot and cold moulding, and blanking of shapes from leather, canvas, or other sheet materials. Full power equal to the moulding pressure is applied to the reverse stroke to open the mould. An air cushion prevents shock.

15 ton Air Operated Platen Press for Plastic and Rubber Moulding

Platen, 17 x 14 in. • Between Columns, 22 in. • Daylight, platen down, 17½ in. • Daylight, platen up, 10½ in. • Advance Stroke, 5½ in. at 6,000 lbs. • Power Stroke, 1½ in. at 30,000 lbs. • Advance speed six times the pressing speed • Cushioned reversal at full power • Capacity—15 tons at line pressure of 80 lbs. /sq. in.; 18 tons at 100 lbs. /sq. in.

Speeds may be adjusted to suit the requirements of any particular moulding operation. The operating cycle is particularly adapted to rapid production. One operator easily handles steady production of several presses.

Investigate the production possibilities of this Hannifin 15 ton press on your own work. Specific recommendations will be furnished if you will describe your moulding problem.

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Pneumatic and Hydraulic Production Tool Equipment

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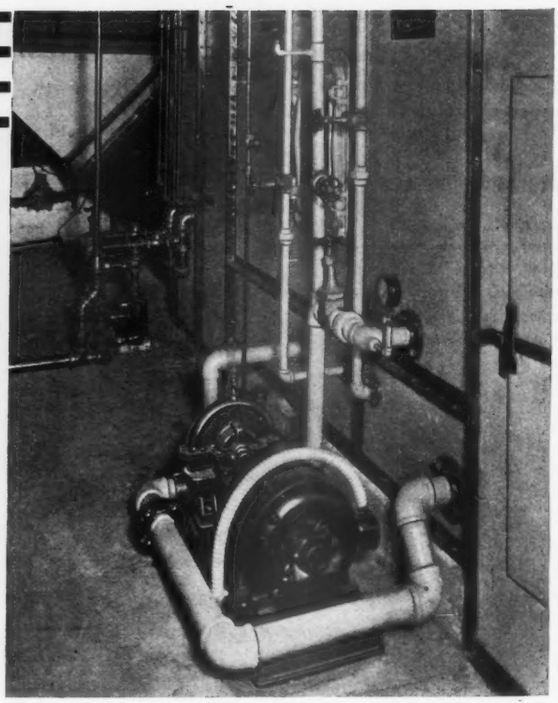
HANNIFIN

15 ton Air Operated

Moulding Press

Oust Dust !!!

SAVE MONEY



Your shop may not be very bad so far as dust conditions are concerned—but it may be a whole lot WORSE than you think!

Play safe in fighting the growing menace of DUST with its explosions, law-suits and general destructiveness, by installing Buffalo Air Conditioning Equipment to eliminate or control dust. Your benefits start immediately upon the completion of your installation and they continue 24 hours a day thereafter.

Because there are so many thousands of Buffalo Air Washers in use, you can be sure that somewhere there were industrial conditions like yours which have been altered satisfactorily by Buffalo equipment. Write us, outlining your dust problems.

Buffalo Forge Company
471 Broadway Buffalo, N. Y.
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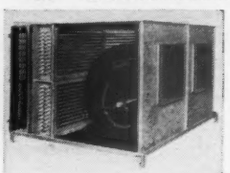


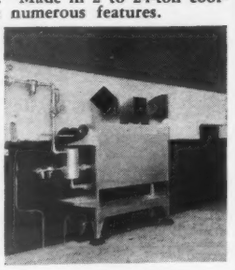
REMEMBER

Buffalo "Comfort Conditioners"

Buffalo "PC" Cooling Units are used to provide conditioned air for offices, stores, cafes, restaurants, etc. Made in 2 to 24-ton cooling capacities. Have numerous features.

Buffalo Unit Coolers

A complete line of units for commercial cooling available for all refrigerants. Hundreds of installations in many industries, all giving excellent service. Bulletin 2967 gives details.



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AIR COOLING
CLEANING, CONDITIONING

selection. In general, rubber cable is the most flexible and can be handled and spliced by men with relatively little experience. Varnished cambric requires greater splicing skill and is not so flexible as rubber, although more flexible than paper. Paper-insulated cable requires an experienced splicer and is not particularly flexible. On the other hand, paper cable is usually more compact than either the rubber- or varnished - cambric - insulated types and may go into a duct that would not carry the others.

Obviously, therefore, when choosing a cable for a certain application, the problem should first be considered from the technical standpoint of size of wire, type of insulation, and type of finish. The facilities and personnel for installation should be reviewed. Then the economics of installation and operation should be considered.

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For Sure, Safe Starting—II

(Continued from editorial page 311)

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Otherwise, control station inclosures are very much like starter inclosures.

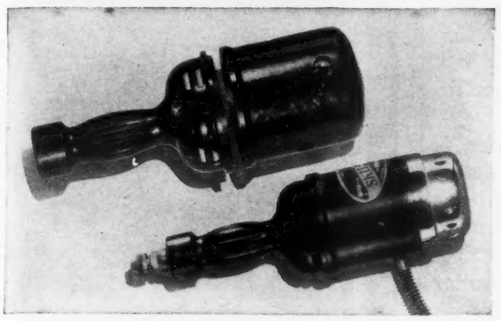
The splash-proof, dust-tight push-button station has been developed for locations where the ordinary type will not give reliable service or proper protection to the operator. It conforms to the N.E.M.A. definition, "apparatus so constructed and protected that external splashing will not interfere with its successful operation," which does not guarantee that moisture cannot get inside the cabinet.

These stations have a gasket between the cover and the cast-iron box which keeps out moisture and dust. The pushbuttons operate in brass sleeves. Hoods for the protruding buttons prevent the entrance of water or dirt.

A low-cost, dust-tight station has been designed with a molded Bakelite cover gasketed to the base. A leather diaphragm allows free operation of the pushbuttons, but excludes dust.

Where a water-tight station is required a cast-iron case with a rubber gasket has proved satisfactory. The

ANOTHER JOB by CHICAGO MOLDED PRODUCTS CORP.



• Portable Electric Tool Housings of MOLDED BAKELITE

The operator of a new Skilsaw Electric Hand Grinder may grasp the housing with perfect comfort and safety at all times. Molded of Bakelite, it provides perfect insulation against heat and electricity.

In addition, its extreme lightness keeps weight down to the minimum; its strength insures real durability. And, incidentally, its handsome appearance is in perfect keeping with the mechanical excellence of the tool.

The same engineering skill which produced these molded parts, is available for the solution of your problem. There is no obligation in submitting details.

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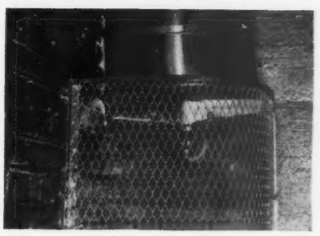
BENDIX FANS *on the job:*



Safeguarding against a gasoline-fume hazard in a mid-western factory

VERSATILE! Adaptable to a thousand-and-one difficult conditions, Bendix P-V-P Ventilating Fans serve virtually every type of industry. Above is shown an installation withdrawing fumes from a battery of gasoline pumps, the explosion-proof motor eliminating all hazard. Bendix P-V-P Ventilating equipment comprises a complete line—ceiling, wall and floor type—16" two-blade to 36" four-blade. Finest heavy-duty construction for long life in severe service.

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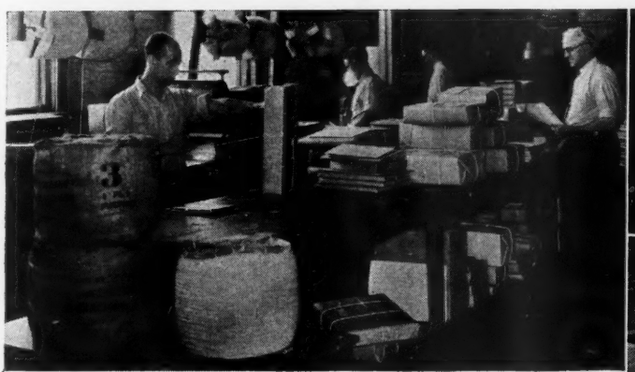

Save on Tying Costs with PACORD

These shipping room scenes are typical of the many progressive factories and industrial plants from coast to coast that have found decided tying economies with PACORD. PACORD is a new, patented Manila twine with Kraft paper covering. It gives greater yardage and strength per pound, is more secure and neater and, above all, materially reduces tying and shipping costs. Learn more about the advantages and economies PACORD offers your plant by mailing the coupon.

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mechanism is operated by the rotation of a shaft in a water-tight bearing.

A similar arrangement is provided for an explosion-proof station, except that the cover and the box are machined to provide a seal without the use of a gasket.

A novel type of control station is used in bakeries or plants where conditions are similar. The pushbuttons are provided with a mushroom-shaped cap that keeps them from becoming clogged with dough or similar material that would interfere with operation, and also presents a large surface, easy to push. If necessary the back of the hand can be used for operating the pushbottons.

A wide choice of inclosing cabinets is now available for every sort of plant condition. Selection of the proper design will do much to insure safety and stability of service.

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Books

(Continued from editorial page 320)

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ciples, five cases showing their application. A textbook for class room or independent study.

•

LABOR AND THE GOVERNMENT

Published for the Twentieth Century Fund, Inc., by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. 373 pages, index, appendixes. $2.75.

An investigation of the rôle of the government in labor relations conducted by the research staff of the Fund founded by Edward A. Filene. Gives understanding of the forces behind recent labor legislation, of the American labor movement by both trade and "company" unions. Presents a specific program for future government action.

•

WANTED: SKILLED LABOR

National Industrial Conference Board, Inc., 247 Park Avenue, New York. 37 pages. $1.

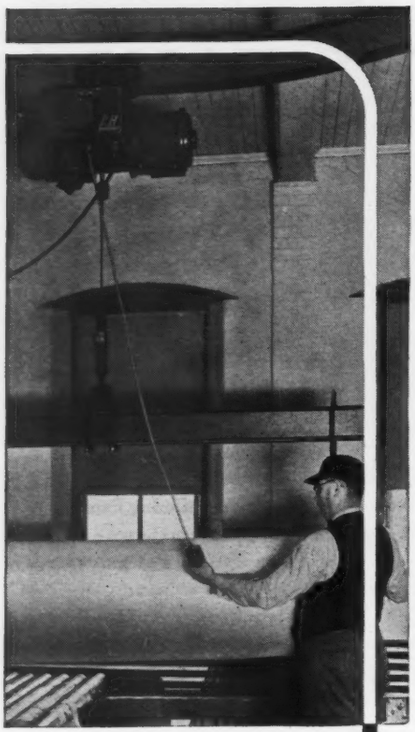
An analysis of the causes and extent of the skilled labor shortage in the metal manufacturing industries and proposals for meeting the situation.

•

ELECTRIC ELEVATORS

F. A. Annett, associate editor of *Power*. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. 483 pages, index, illustrated. $5.

Second edition. Covers the subject from description of types to procedure for inspection, lubrication, and maintenance.



LITTLE DROPS would cost BIG MONEY here!

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The paper used for currency and bank notes is expensive rag stock—it must be protected against damage from oil. That's why this New England manufacturer installed P&H Hoists. They're *drip-proof!*

It's only one feature of P&H's advanced line of hoists to give you safer, faster, more economical handling.

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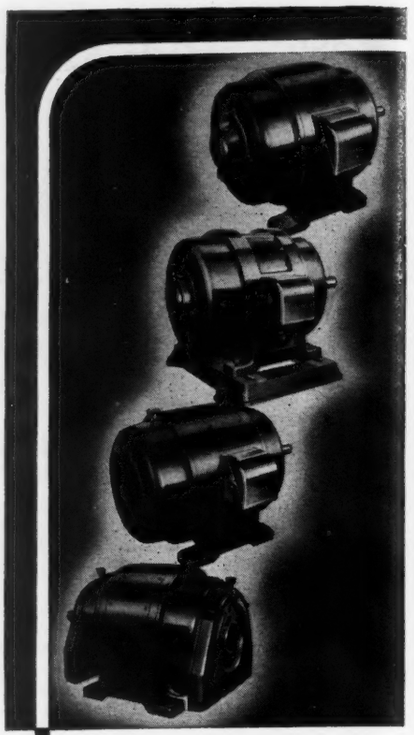
P&H MILWAUKEE ELECTRIC HOISTS



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When we designed these new P&H Convertible Motors, we compared every advantage and disadvantage of existing types. We put hard drawn copper rotor bars in straight semi-enclosed slots; we electrically brazed them to the end ring to make them indestructible; we put both sleeve and ball bearings in capsule mountings to seal them against dirt and dust for trouble-free service.

Then, we made these motors *convertible.* Standard interchangeable parts allow you to convert any of these P&H motors for open type, enclosed fan cooled, splash proof or totally enclosed applications. And this extra feature which protects you against costly replacements doesn't cost you a penny more.

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